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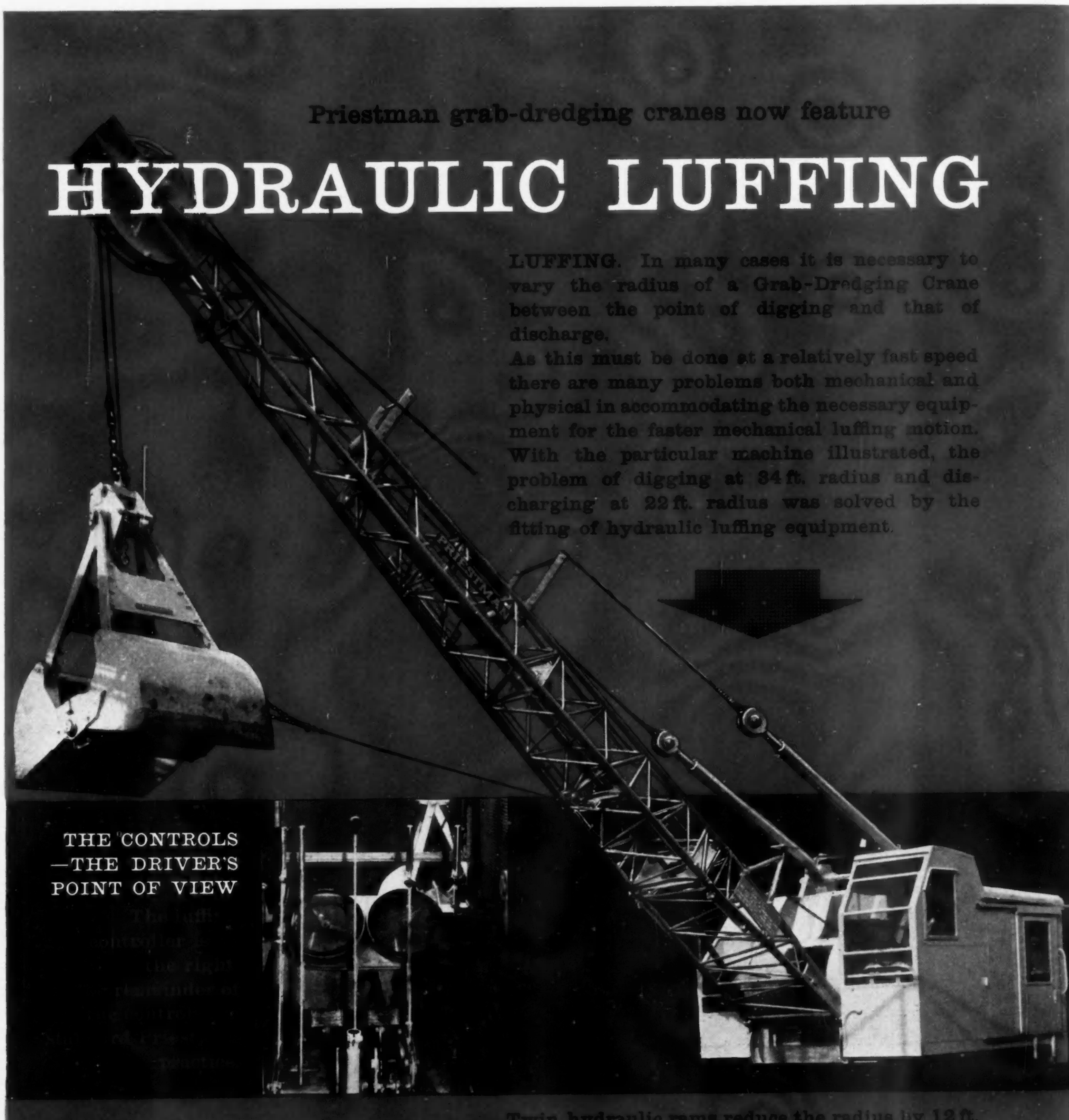
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The Dock & Harbour Authority

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Editorial Notes

The Port of Helsinki

The development and prosperity of small nations depend on their communications with the rest of the world, and Finland, which has an extensive coastline bounded by the Gulfs of Finland and Bothnia, is fortunate in possessing many harbours. Only a few are of commercial value, however, and these are in close proximity to the industrial and commercial centres, or have been sited on transport routes convenient for the export of the country's products which consist chiefly of timber, paper, wood pulp and cellulose.

The largest and most important port is Helsinki, which is situated in a central position on the south coast and possesses a well-sheltered harbour protected by an archipelago with low cliffs and islands separated by deep channels. With these advantages, it has naturally become the main passenger port of the country, and this traffic is increasing yearly. Readers will recall that in our January 1956 issue we published a detailed description of the modern passenger terminal which has been constructed in the South Harbour.

Helsinki is the capital of Finland and also the largest industrial city in the country, and the processing of raw materials is centred on the town and its environs. It therefore has become the most important import port in Finland and has excellent facilities for the storage and processing of foreign products. The article on a following page describes the development of the modern port, and also gives details of the plans in hand for the erection of further warehouses and for the installation of additional cranes and other mechanical handling appliances.

It is evident that the Harbour Board is looking forward to a vigorous and growing trade, and is making provision to handle any commodity by the most modern methods.

Ships' Gear

As means of lifting cargo into and out of ships' holds have improved, two schools of thought have developed. On the one hand, there are those who are convinced that general cargo vessels should be capable of being discharged and loaded entirely by their own equipment; on the other, there are those who advocate quay cranes.

As is usual in such cases, this is not a clear-cut issue. Ships having no cargo handling gear cannot discharge or load at buoy berths or at wharves without cranes; even when ships have first-class gear, it is by no means frequently used at "crane" ports. Many European port operators will deliberately choose to use quay cranes, believing that by employing these machines higher outputs will be achieved. Few U.S. ports, however, have any quay cranes, most port interests in that country arguing that ships should have their own gear—and use it! The most the U.S. ports will usually do is to provide a winch and a runner on the quay to enable a union purchase to be operated by marrying the quay runner to the ship's runner.

Present attitudes to this matter were examined in an article, "The Ships' Gear and Quay Cranes Controversy," which appeared in our issue of July 1958. Both quay cranes and ships' gear are evolving, the latter in a more spectacular fashion. Deck cranes of varying capacities and many different types—fixed and on tracks — are becoming common on new ships and in some quarters there is now a subsidiary controversy concerning the relative merits of ships' derricks and ships' cranes.

An investigation into this particular question was made recently in the United States, when the maritime Cargo Transporation Conference collected data during the discharging and loading of three general cargo vessels equipped respectively with derricks and steam winches, derricks and electric winches, and electric deck cranes. Extracts of a paper dealing with this investigation were printed in our issue for November last.

The main argument put forward in favour of quay cranes is that they can plumb an area, whereas derricks and married falls can only plumb a point. Any appliance which is capable of luffing as well as slewing has this advantage and on page 281 of this issue we print an article on yet another new type of discharging and loading equipment, a ship's derrick with hoisting, slewing and luffing motions, all easily controlled by one man driving an electric winch. Another important feature of this appliance, which has been patented in Holland, is that it has good outreach. This, particularly, will please the advocates of ships' gear, for it is in the sphere of outreach that ships' cranes often fail to rival their counterparts on the quay.

The Inter-Governmental Maritime Consultative Organisation

The first assembly of the Inter-Governmental Maritime Consultative Organisation opened with a flourish of trumpets, but there were soon a few discordant notes. Russia wanted the Pekin Government to represent China; Liberia (with the active support of America) wanted a seat on the council and India made a reservation so wide in its implications that it would leave her free to follow her own course on almost every subject. Few international organisations ever seem able to avoid irritating disagreement and I.M.C.O. is no exception. Flags of convenience have been the chief element of dispute. The United Kingdom Government delegates have contended that the Panhonlib countries are not truly national maritime powers. In that they have the full support of British, and other shipowners. Liberia, ranking third, in nominal ownership at any rate, among the world's fleets, and Panama, listed eighth, claimed automatic election to the maritime safety committee as being among the eight largest shipowning nations. This proposal was resisted by the United Kingdom and other maritime countries, so there is the spectacle of I.M.C.O., in its very earliest days, having to seek the opinion of the International Court of Justice on what the phrase "largest shipowning nations" means in Article 28 of the convention.

It certainly looks as if the Flags of Convenience controversy

Editorial Notes—*continued*

will be I.M.C.O.'s major headache and, whatever the opinion given by the International Court, no one is likely to be satisfied. When the question of flag discrimination comes up, will America, in return for her support of Liberian and Panamanian claims, expect reciprocity? It must be remembered that America is strongly criticised for her cargo preference practices which, based on legislation, has given other countries the pretext to make trade treaties allocating the whole or part of their cargo to ships of the national flag.

Collusion among some nations was foreseen many years ago when I.M.C.O. was first seriously discussed. There was also seen the risk that the organisation, because of its wide terms of reference, might try to take a hand in matters belonging strictly to the commercial sphere. Echoes of this state of mind were heard at the opening meeting. The American delegate, in particular, expressed pleasure that no provision had been made by the preparatory committee for any economic activity in its working programme for the first two years. He pointed out that when America ratified the convention she believed, as she still believed, that the organisation should not make "extended excursions," as he put it, into the economic field. Here America will find Britain and many European shipping countries in line with her. But with an organisation that contains a strong representation of transport users, who may see their interests in a different light from those of the transport providers, zeal may overcome discretion.

It should be the principal task of I.M.C.O. "to consider those problems affecting international shipping which, at present, do not come directly within the remit of any of the existing agencies of the United Nations, or which hitherto have been dealt with by special international conferences." That was the outline of its functions given by Mr. Harold Watkinson, the Minister of Transport, in welcoming I.M.C.O. to London—the first of any specialised agencies of the United Nations to have its permanent home in the British capital. He went on to say that shipping could only develop its fullest potential if, by means of international consultation and agreement, the barriers that hamper and constrain the full expansion of its activities are removed. This hint that I.M.C.O. is consultative and not legislative will, it is to be hoped, have registered in the minds of the delegates.

It had been thought that I.M.C.O. would have settled its programme of work in the first week, but that is not the case and the stay of the delegates in London has been prolonged. I.M.C.O. will take over responsibility for duties under the international convention for safety of life at sea, which is due for amendment in 1960. These have hitherto been carried out by the United Kingdom Government. The new body will also assume responsibility for tonnage measurement, the prevention of oil pollution, and other technical matters. The general assembly will not meet again until 1961.

The early days of I.M.C.O. will be a testing time. Its success will materially depend on its keeping in step with the shipping opinion of the world. It is early yet, of course, to see to what extent its activities will have on impact on docks and harbours, but it seems likely that some impact is inevitable.

Cargo Handling Delays at Colombo

The United Kingdom and Continent to Colombo Conferences have announced that outward freight rates from the U.K. and the Continent to Colombo will be increased as from February 2nd. This step has been taken as a result of the increased costs of discharging cargo and the prolonged delays experienced by ships. In a recently issued statement it is pointed out that the shipping lines themselves can no longer continue to bear the costs involved, and have, in fact, deliberately refrained from increasing rates to the extent that would wholly compensate them for the higher costs. They had hoped that the present difficulties at Colombo would be resolved, but it has now become apparent that no early improvement can be expected. They have therefore been forced to review their freight rates to arrive at a more realistic level.

A further series of strikes is again interfering with work in the port and, despite constant efforts made by the Ceylon Government to improve labour relations, including nationalisation and the setting up of a Port Cargo Corporation, which began operations last August, labour unrest continues to disrupt the port. Last October the Minister of Nationalised Services and Road Transport appointed a special commission to examine the whole question of port operations, and foreign advisers who have been called in have stated that, with the greater mechanisation now in progress, there is no reason why the port should not be able to handle 10,000 tons of cargo a day. An essential factor, however, is freedom from labour disputes and, so far, the Government has not been able to achieve this.

In face of the most recent strikes, the Governor-General summoned a conference to discuss the problem. It was stated at this meeting that 100 lighters would be delivered to the port within the next few months and this would contribute to the improvement of ship turnround. One member of the Board of the Port Cargo Corporation, however, pointed out that what is lacking in the port is not only equipment but also discipline. He stressed that most of the strikes were due to trade union rivalry in the port and that, although the Government had declared the port an essential service, it had brought the law into contempt by not enforcing the Essential Services Order.

No other port in the world has had such a post-war record of continual labour troubles, and it is not surprising that ships which usually serve Colombo are beginning to by-pass the port altogether. It is to be hoped that the Government of Ceylon will adopt strict measures to effect an improvement before the foreign trade of both port and country is brought to a standstill.

Development Plans for East African Harbours

The Transport Advisory Council and the Railways and Harbours Committees of the East African Railways and Harbours recently met to consider the draft budget for 1959. A variety of transport problems were discussed and recommendations made included, inter alia, increases in the marine charges at East African ports, new harbour works, and the purchase of a new berthing tug.

The Advisory Council recommended increases in the charges levied against ships using East African ports for the services of pilots and the use of berthing tugs and for mooring and unmooring services; details of the proposed increases will be announced shortly.

The principal new harbour work approved was the construction of an additional transit shed at the Princess Margaret Quay, Dar-es-Salaam. The new shed which is expected to cost £150,000, will have a capacity of approximately 110,000 sq. ft. and will partly replace a shed destroyed by fire in 1957 and other sheds recently demolished at the end of their useful life. It will give increased capacity for handling exports and so enable cargo operations to be concentrated more at the deep water berths.

Agreement was also given to the purchase of a 1,000 h.p. diesel berthing tug to replace the steam tug "Linden," and to the replacement of the pilot cutter by a new twin-screw vessel.

Malta Harbour Development Scheme

During a recent broadcast outlining the interim arrangement for carrying on the government of Malta, the Governor, Major-General Sir Robert Laycock announced that the United Kingdom Government had decided to make available a sum of up to £29 million over the next five years to assist in the economic development of the Island. The programme will include the rehabilitation of the dockyard which, subject to the completion of a satisfactory agreement, is to be taken over by the English firm of G. A. Bailey Ltd., who will assume full responsibility for its commercial development. It is confidently expected that there will be enough work in the Mediterranean to keep the dockyard fully employed in future years.

Plans have also been completed for the construction of the civil harbour and a contract has been let to the Royal Netherlands Harbour Company. The work comprises the building of a deep sea wharf and the erection of a large grain silo. The first piles for the wharf were driven early this month, and it is expected that the civil harbour will be completed within two years.

The Port of Helsinki

Its Growth and Development as the chief Port of Finland

By KRISTIAN EIRO (General Manager)

THE town and port of Helsinki was founded in 1550 as a result of an attempt by King Gustavus Vasa of Sweden and Finland to break the stranglehold of the North German towns over the trade of the Baltic. The privileges held by Lübeck merchants denied Swedish and Finnish traders the right to engage in commerce west of the Danish straits, and the trade was directed exclusively to the member towns of the Hanseatic League on the south Baltic. The town of Tallinn, established at the beginning of the 13th century as the northern base of the Hanseatic League, played a prominent role at this time in the economic life of the south coast of Finland. The establishment of the port of Helsinki was designed to end the dominance of Tallinn in trade between Russia and Finland, but this aim was not achieved.

The site of the harbour, at the mouth of the River Vantaanjoki at the end of a shallow bay, was unfavourable and the town therefore had to be moved in 1640 to the site of the present Northern Harbour on the Vironniemi peninsular. In spite of this improved situation and the advantages derived from a decisive change which occurred at the beginning of the 17th century when the foreign trade was directed west of the Danish straits, so by-passing the Hanseatic towns, the development of Helsinki was little furthered and it continued to be an insignificant port handling a relatively small trade compared with the other ports of the country.

After the long wars of the 18th century, however, commerce and shipping at Helsinki showed distinct signs of improvement. The merchants of the port already had several vessels of their own sailing down to the Mediterranean to bring back the most important commodity of salt, and small quantities of certain other products of the southern countries. The most important export goods were tar, timber and occasionally, grain.

In 1812, Helsinki was made the capital of Finland and a new and vigorous phase began in its development. It became the main port and economic and cultural centre of Finland, surpassing the former capital, Turku.

After the industrial revolution had spread to the country during the 1860's, transport facilities improved with the construction of channels, canals and railways and, with the use of steam power, manufacture of wood products developed into an important export industry. The shipping and harbours of the country began to play an increasingly important part in the handling of foreign trade, although a great proportion of this was with Russia across a land frontier.

In the first half of the nineteenth century, harbour traffic in the port of Helsinki was still concentrated on the North Harbour, which was equipped with only one pier. In the bay which now forms the South Harbour, however, two wooden piers had been constructed during the 18th century. In both these harbours, warehouses had been built on the waterside to enable lighters to tie up alongside.

During the years 1812—1825, the central section of the South Harbour was given approximately the form it has to-day. In 1893 began a new phase of construction in this harbour and, by the beginning of this century the old part of the Passenger Quay and its warehouses had been built. The old part of Katajanokka Quay was also constructed at the turn of the century with a large Customs and warehouse. During the same period, building of the West Harbour was commenced where the present Hietalahti quays were built in 1893—1895. With the laying of the first railway to the various harbours of the port, a wooden pier was built in Sörnäinen Harbour in 1865, but West Harbour and South Harbour were not supplied with railway communications until 1895.

A third phase of construction began in 1913 in the West Harbour and, after ten years' work, the present general cargo harbour (Jätkäsaari) and coal harbour (Saukko) were placed in use. The coal harbour was considerably enlarged during the years 1928—1933. Construction of Herttoniemi harbour commenced in 1931 and, in this part of the port were sited the oil storage areas and various industrial plants.

Position of the Port To-day

The stages of construction reviewed above gave the port five different harbours; the West, South and North Harbours, Sörnäinen Harbour and Herttoniemi Harbour. A further harbour is being established at Laajasalo for the handling of oil imports. The trade of the port is directed to whichever harbour is best equipped to handle the particular types of traffic.

West Harbour accommodates for the most part the trans-oceanic traffic, heavy goods and bulk cargoes. In this area of the port is also sited the coal harbour with all the necessary discharging equipment and storage facilities. Here also, at the quayside, are the silos of the two flour milling plants (Vaasan Höyrymylly and the State Granary), into which grain is discharged by suction. The main bulk export cargoes loaded in this harbour are cellulose, paper and wood articles.

South Harbour is mainly for general cargo traffic and is used by vessels in the Baltic and North Sea traffic. Foreign passenger traffic is concentrated on this harbour and, on its north side, Katajanokka, are the warehouses of the large wholesale firms and general bond warehouses owned by the municipality.

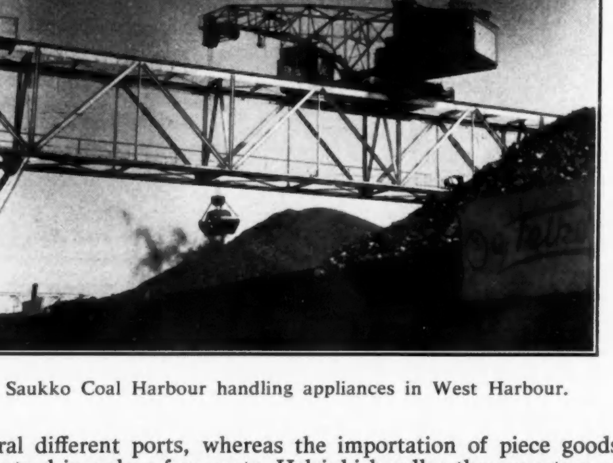
North Harbour now only serves ferry and launch traffic to the adjacent islands and vessels bringing building materials to the city.

Sörnäinen Harbour is the old timber export harbour where the timber was loaded direct from the railway wagons or motor trucks. Earlier, oil imports were concentrated here but, since 1936, they have largely been transferred to Herrtomiemi and recently to Laajasalo. Sörnäinen Harbour is at present being reconstructed and in the future will handle the coal imports.

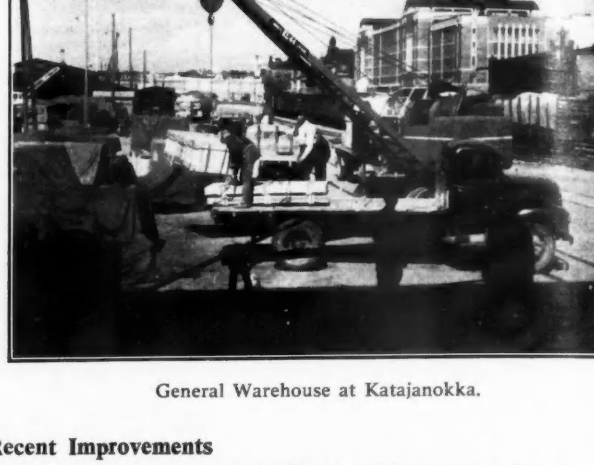
Herttoniemi Harbour was, as already mentioned, first designed as the port's oil harbour, but it is now being superceded by Laajasalo. The three largest oil companies have already built themselves storage tanks at Laajasalo and more companies are taking up sites there.

The importance of Helsinki to the foreign trade of the country is due to its position as the natural centre of the densely populated southern part of Finland. The population of the city has increased rapidly from 74,000 in 1895 to over 400,000 to-day. It is the largest industrial town in the country and the processing of raw materials has centred on it and its immediate vicinity. The principal export industry, the manufacture of wooden articles, is concentrated in the eastern and northern parts of Finland, but Helsinki grew as a port because of its facilities for the storage and processing of import goods. It now has more technical equipment than all the other harbours of Finland together. Furthermore, it possesses bond warehouses in which goods may be stored without Customs clearance for two years, as in a free harbour. Private importers, also have their own Customs storages, in which uncleared goods may be kept for three years. The port has a quay goods service under the harbour authorities which receives goods, especially piece goods, on behalf of owners, lists and stores them and is responsible for them until they are handed over. In terms of value, over half the goods coming to Finland by sea arrive in Helsinki; in terms of weight, about one-third of Finnish imports enter through the port. This difference is due to the fact that coal, coke, fertilisers and industrial raw material imports are divided between

The Port of Helsinki—continued



Saukko Coal Harbour handling appliances in West Harbour.



General Warehouse at Katajanokka.

several different ports, whereas the importation of piece goods is centred in only a few ports. Helsinki handles threequarters of the piece goods imports.

Traffic in the port of Helsinki reached its pre-war level in 1947 and has continued to increase since then. However, because Helsinki is a typical import harbour, its traffic reflects world fluctuations of trade. For instance, in 1953 when trade depressions in the woodworking industry had forced manufacturers to cut production—the cut was made in the previous year —and export earnings therefore diminished, it proved necessary to reduce imports and Helsinki harbour suffered accordingly. Since 1954 commerce has again increased but, unfortunately during the current year, business has again slackened considerably owing to the economic crisis at home and the international recession.

The following figures will show the traffic of the port in recent years:

	SHIPPING		GOODS TRAFFIC		
Year	No. of ships	Net reg. tonnage	Import tons	Export tons	Total tons
1938	2,497	2,239,503	1,293,000	288,000	1,581,000
1955	2,716	2,451,892	2,184,000	442,000	2,626,000
1956	2,544	2,267,043	2,366,000	467,000	2,833,000
1957	2,874	2,438,775	2,455,000	377,000	2,832,000

Winter Navigation in the Port

In the past, Helsinki harbour traffic round Harmaja lighthouse has been hampered by severe winter ice with the result that the port has been closed for periods of from 4 to 6 weeks. This happened last in 1951. Recently, however, powerful additions to the Finnish ice-breaker fleet have been made and further ice-breakers are on order so that, in future, the port of Helsinki will remain open for traffic throughout the year. The opening in 1955 of the Porkkala channel, which is protected by islands from the open sea, is also of considerable assistance to the port's winter traffic.

Helsinki has two ice-breakers of its own (one of 1,880 h.p. and one of 960 h.p.), which assist vessels in the port area and, if necessary, in the channels through the archipelagoes.

The growing traffic is making ever-increasing demands on the port installations and the City of Helsinki is endeavouring to keep up-to-date by building new docks, quays and warehouses, ordering new technical equipment and repairing and renovating old docks. and quays. To cope with the modern shipping conditions, fully renovated docks and quays, comprising an approximate length of 900 metres, with depths of 7.6—9.5 metres, have been completed since 1950. The warehouse floor area has been increased by about 21,500 sq. metres. The port now has a total length of some 6 km. of berthing accommodation for sea-going vessels and about 121,500 sq. metres of warehouse area.

Recent Improvements

Work is proceeding on the Katajanokka quays to increase their total length. This harbour area contains the deepest water quays in the port. A three-storey heated warehouse is also being built and this will have a floor area of approximately 9,000 sq. metres.

The new passenger terminal in South Harbour*, which was completed in 1953, last year handled 49,343 incoming passengers and and 50,103 outgoing. The corresponding figures in 1956 were 47,694 and 47,602, and in 1954 43,339 and 44,523.

The passenger terminal covers an area of 31,000 cub. metres and contains on its ground floor storage accommodation, 2,200 sq. metres in area, and on the second floor a customs hall 1,500 sq. metres in area, an entrance hall and café rooms totalling 750 sq. metres. In addition, there are offices for Customs and police authorities.

Passengers disembark via ship's ladder and special bridges leading to the examination hall, or from the quay lifts to the hall. Luggage is transferred by crane from the vessel to the terminal's loading platform, from where it continues along a roller track for distribution between the examination counters. On the ground floor is a separate Customs office for the examination of important goods, an air conditioning plant and a power

* A full description of this facility was published in the January, 1956, issue of "The Dock and Harbour Authority."

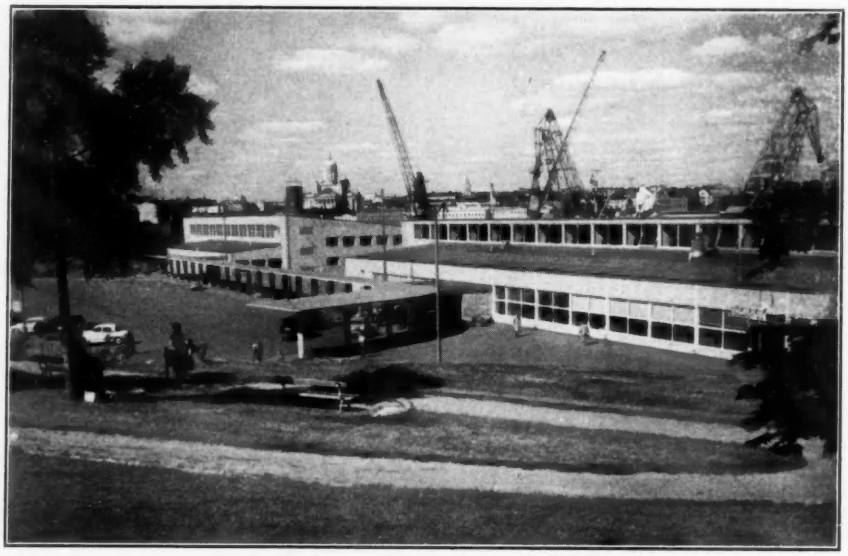
The Customs Examination Hall, in the passenger terminal at South Harbour.

The Port of Helsinki—continued

The Port of Helsinki—continued

transformer serving the entire complex. Heating is provided from the Customs warehouse nearby which houses a central heating plant.

The old passengers' quay in the South Harbour is to be reconstructed for about 300 metres of its length and will then be considerably widened. The old warehouse will be pulled down and the new one to be built in its place will be a single-storey, partly heated warehouse with a floor area of approximately 4,000 sq. metres.



Passenger Terminal in South Harbour.

In future years the main focus for new building and expansion will be the West Harbour. The present coal harbour at Jätkäsaari, which has an annual turnover of about 1 million tons of coal, is to be transferred to Sörnäinen. The Jätkäsaari quay will then be lengthened and equipped with railway sidings. Plans are in hand for several new warehouses, including a large bonded warehouse, to be built there.

The new coal harbour in Sörnäinen is partly ready for operation with 365 metres of quay completed and four powerful coal hoists already installed. A new dockside crane with a lifting capacity of 150 tons is also being constructed for use on this quay.

The new oil harbour being built at Laajasalo, where an area of 52 hectares has been reserved for the purpose, will accommodate the country's three largest oil companies, the Finnish subsidiaries of Shell, Esso and Gulf, and unloading berths and storage will be provided.

Social facilities for the port workers have been provided in Katajanokka (14,210 cu. metres) and the West Harbour (12,500 cu. metres), in addition to the old social building in the West Harbour which is being modernised. In this latter harbour are also to be found repair and maintenance shops for harbour machinery and a modern social centre for Customs personnel. In Sörnäinen, a modern social building is to be built in 1959 to replace the old one built in 1947.

The summer programme this year included hard-surfacing the quays in all the harbours, improving the railway tracks and roads and other works.

Handling equipment in the port has undergone considerable improvement since 1950, 29 new cranes have been acquired, of which one has a 25-ton capacity. By the end of this year, in addition to the cranes already ordered, the 150-ton capacity crane mentioned above will have been installed. This will increase the number of cranes in the port to 78. Mobile cranes, fork trucks and tractors have been purchased and there are now 60 of these in the port.

Submarine Pipelaying

Development of Convenient and Economic Technique

By J. P. M. VERHAAK

Introduction:

In this day and age pipelines are being used extensively as a means of transportation. They are taken over short or long distances, through towns, fields, over mountains, through rivers, harbours, tidal waters, etc., under high or low pressure or under vacuum, under high or low temperatures. This article, however, is focused solely on the subject of submarine pipelaying of steel pipes.

Modern techniques of constructing and laying submarine pipelines were developed during and after World War II. For instance, the famous PLUTO line serving the allied forces on the Continent with petrol, etc., was one of the longest submarine pipelines ever laid.

Designing and laying these kinds of pipelines is a very specialised branch of engineering which needs many years of concentrated study and experience. Practically every type of harbour or river crossing, seagoing line or sewer sea outfall can be constructed after careful study of the scheme, prevailing circumstances, weather conditions, tidal information, nature of seabed, borings, current observations at seabed and water surface level, etc.

Methods:

There are three methods of laying submarine pipelines in popular use. These are as follows:—

(a) Construction of a pre-shaped pipeline on a site along the water's edge, launching, floating into position and sinking.

(b) Construction of a pipeline ashore in the direction of the proposed route in one or more sections and pulling out over the river, harbour, or seabed or through a dredged trench.

(c) Construction of a pipeline from a "pipelay barge" or "floating factory", the completed section being laid whilst the floating unit travels along the route during the production process.

Which method should be adopted for each particular scheme naturally depends on local conditions.

Survey:

To ascertain conditions likely to be encountered on any one scheme, a comprehensive survey must be carried out. Normally this survey consists of the following:

(a) Preliminary discussions with River, Harbour and/or other Authorities concerned with the scheme.

(b) A detailed echo sounding survey of the area.

(c) Surveying of the construction site and approaches of the submarine line to the shore.

(d) Making borings to a depth equal to that to which the pipeline has to be buried to investigate conditions at that level.

(e) A study of tidal conditions.

(f) A study of the force and direction of any current along the pipe route in order to determine the influence it will have on the pipeline during pulling operations and after the pipeline has been laid.

(g) A study of the meteorological conditions.

Submarine Pipelaying—continued

Launching Pre-shaped Pipeline by means of Floating Cranes.

(h) Investigations to determine the most economical route for the submarine pipeline.
(j) Investigation of seawater to determine the type of outside protection necessary for the pipeline.
(k) Determination of stresses in the pipe material.
(m) The preparation of contract drawings and specification.

Trenching and Backfilling:

In cases where pipelines have to be buried beneath the seabed, a trench has to be prepared. For small crossings this can be achieved by means of a dragline from the shores or with a grab-dredger from a barge; backfilling can be done in the same way. Soil can be temporarily dumped on the shores. For larger crossings and up to a depth of approximately 60-ft., a bucket dredger can be used. The soil is dumped in barges and carried away. After the pipeline has been laid in the prepared trench, the soil is placed on top of the pipe by means of barges or hoppers. Trenches can also be made with a cutter suction, or suction dredger and the soil carried away. In certain instances backfilling need not be carried out where the flow of the water is sufficient to fill the trench by natural means.

New devices have been developed for trenching a pipe after pulling over the seabed. Mechanically propelled or jet, trenchers travel over the pipe and dig or jet a hole beneath the underside of the pipe, giving sufficient room for the pipe to settle, the soil being carried away by the current. As these methods can only be used in soft soils and do not always give reliable results, owing to the difficulty of checking the depth, normal dredging is favoured in most cases. A further unfavourable point with the new devices is that stresses during jetting-in cannot be calculated; it may be that the pipe material will be overstressed to the yield. This, of course, is unacceptable for high pressure lines.

The foregoing does not apply to instances where rock is in existence on the seabed. In such cases it is necessary for divers to inspect the rock surface in order to determine if the rock can be removed by rock-cutter, suction, or bucket dredger for soft rock, or by the blasting method for hard rock. Broken rock can be removed by dipper or grab.

Construction of Pipelines

At a predetermined area the pipes will be unloaded, strung out and welded together to make one or more sections. Each weld is checked visually and by means of radiography to ensure that the welds are sound and 100% perfect. The pipes can be cleaned internally by passing a "scraper", "pig" or "go-devil" through the pipe. An air and/or hydraulic test is then applied to check the soundness of pipes and welds.

After satisfactory testing, coating and wrapping can take place. In many cases the pipes are factory coated and wrapped. Several types of coating and wrapping can be applied but for submarine pipelines the heaviest coating will always be specified.

Bituminous coating and wrapping is checked for water-tightness and soundness by means of a "Holiday" detector—this device can detect the smallest pinhole.

A concrete coating of pre-calculated thickness is applied to the pipes. This coating has a dual purpose—to keep the pipes down in the water and also to protect the bituminous layer around the pipe during handling against mechanical damage. For small pipes a thickness of 1½-in. to 2-in. of concrete applied by the spray method is the most economical but for large diameter pipelines a thick layer of concrete applied by the shuttering method is advisable. A square wire mesh is used as a reinforcing material, the diameter of the wire depending entirely on the thickness of concrete to be applied. The final finish of the concrete coating will be smooth and solid. This coating, however, should only looked upon as a means of protecting the bituminous layer during pulling and as extra weight to the pipes in water—any cracks which may appear in the concrete coat will not harm the bituminous coating and wrapping.

Launching:

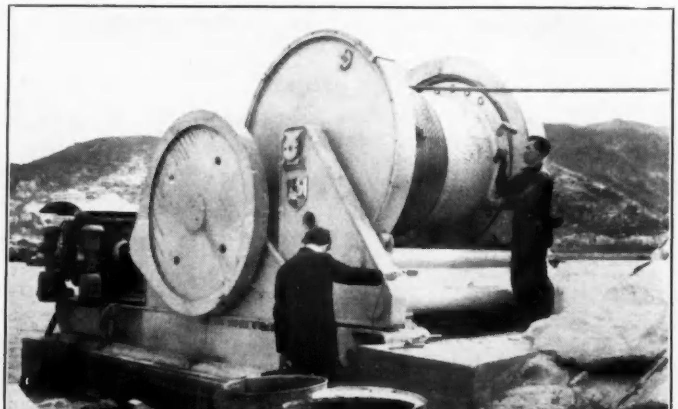
1.—Launching pre-shaped pipes can be executed as follows:
(a) Floating cranes take the entire pipeline and carry it to the correct location for sinking.
(b) Pipes can be launched from a slipway, floated over the water to the sinking line, weighted by means of filling the lines with water and brought into position.
(c) Pipes launched from the shore, carried by floats, towed to the sinking line and sunk by means of winches mounted on the decks of the floats.

2.—Launching and pulling of a straight pipe over river or seabed or through a trench:

Immediately after completion of the section(s) and after sufficient curing of the concrete, the section will be placed in con-

Pulling Operation in Progress.

Submarine Pipelaying—continued



(Left) Pulling Head and Buoy. (Above) Pulling Winch. (Right) Pipelines on specially constructed pneumatic rollers.

veyors. These pneumatic-tyred self-stabilising conveyors carry the pipe from the shore into the water. All the wheels are fitted with roller bearings to ensure a very low friction factor and also a very low pulling force. These conveyors are aligned horizontally and vertically to ensure accurate launching, and fitted with six wheels, thus making sideways movement of the pipe in a horizontal direction impossible, these forces being taken by the wheels. Rubber-tyred wheels are necessary to prevent the concrete coating suffering any mechanical damage during pulling operations. To overcome certain difficulties pipes can be laid in a predetermined and calculated "radius of curvature". If during construction the contractor takes the necessary precautions, the pipe will follow the "radius of curvature" without difficulty and without cracking the concrete.

Before pulling the pipe, a steel wire rope of sufficient strength will be laid over the seabed from a winch and attached to the pulling head of the pipe. To reduce the pulling force, buoys can be attached to the pipe before launching, the spacing and nett buoyancy of the buoys being calculated carefully and checked before commencement of the pull. The negative buoyancy of the pipe can be reduced to any figure between 3 to 25-lbs./ft. dependent upon the diameter of the pipes, underwater current, etc. The buoys are strapped to the pipe in such a way that they can be slackened by pulling a trip wire running along the entire length of the pipeline. The pulling-head is attached to a floating buoy to mark the position of the pipe.

The actual pulling force is delivered by a powerful diesel driven winch giving a direct pull of up to 200 tons at a speed of 5 to 100-ft./min. The pulling force is checked continuously by a built-in dynamometer. The winch can be placed on a special concrete foundation for taking the reaction force, or alternatively on a barge, in which case the back anchors take the reaction force. The anchors can be made up of either concrete blocks or Danforth anchors, or specially constructed from steel plate.

To keep the pipe as straight as possible during the pulling operation, a special winch with a steel wire rope is attached to the end of the pipe to ensure a predetermined back-hold strain, which is also checked by means of dynamometer readings.

During the pulling, the position of the pipe in the trench, or on the seabed, is checked by echo soundings taken from a survey boat at regular intervals.

In contrast with the floating method, this way of launching lines does not interfere with shipping in the harbour or river.

3.—The "Pipe-Lay-Barge" or "Floating Factory" Method:

In this case no sections are assembled at a construction site ashore but single pipes, already bituminously wrapped and coated and concrete weight coated, are transported to a large barge on which a ramp is built equipped with pneumatic-tyred rollers. The ramp is divided into five bays—two welding bays, one radiographic bay, one bituminous coating bay and one concreting bay. A crane swings the pipes on to the ramp and as soon as all sections in the bays are ready the barge moves one pipe in the direction of the route. The ramp is fitted with an extension, also equipped with rollers, for guidance of the pipe to the bottom. This extension can be lowered or moved upwards by pumping water or air into the attached buoys. Pipes any length can be laid by this method.

Cathodic Protection:

The application of cathodic protection to a steel pipeline used for a water crossing is strongly recommended. The method prevents the removal of steel ions in solution by forcing the steel to a sufficiently high negative electrical potential with respect to the surrounding electrolytes. Depending on circumstances, one of the following two systems can be used:

(a) Sacrificial anode system, where a differing metal is mechanically connected to the pipeline and buried in the neighbourhood of the pipeline to produce a galvanic cell in which the pipeline becomes the cathode. This method is limited by the low driving voltage available but is suitable where circuit resistance is low.

(b) Impressed current system where a mains or powered D.C. source supplies the electrical potential difference between the pipeline and a graphite-anode-bed, the pipeline being the cathode. Greater power is available with this method.

Insulation flanges are installed at the start and end of the crossing to ensure that no current from any other source can flow in or from the submarine lines. The cathodic protection system only is connected with these pipes. It always pays to consult a specialist firm for the determination of cathodic protection.

Conclusion:

From the foregoing it is evident that no matter what type of pipeline is proposed and no matter where it is to be located, a suitable method can be developed. Each method has its advantages and disadvantages, for instance the pipe-lay-barge method is suitable for use in lakes or calm waters without swell, etc., and to a depth of approximately 30-ft., but it is impossible to calculate the stresses which will occur in the pipe material and the bending stress will increase tremendously during stormy weather.

The pulling method has its disadvantages but in comparison with the advantages of controlling stresses, this method is the most highly recommended and is favoured by the majority of oil companies.

Finally, close co-operation between Principal and Contractor can be rated as one of the highest essentials for the successful completion of all submarine pipelaying schemes.

Modern Applications of Steel Sheet Piling

By L. DESCANS
(Honorary Chief Engineer of Bridges and Roadways, Belgium).

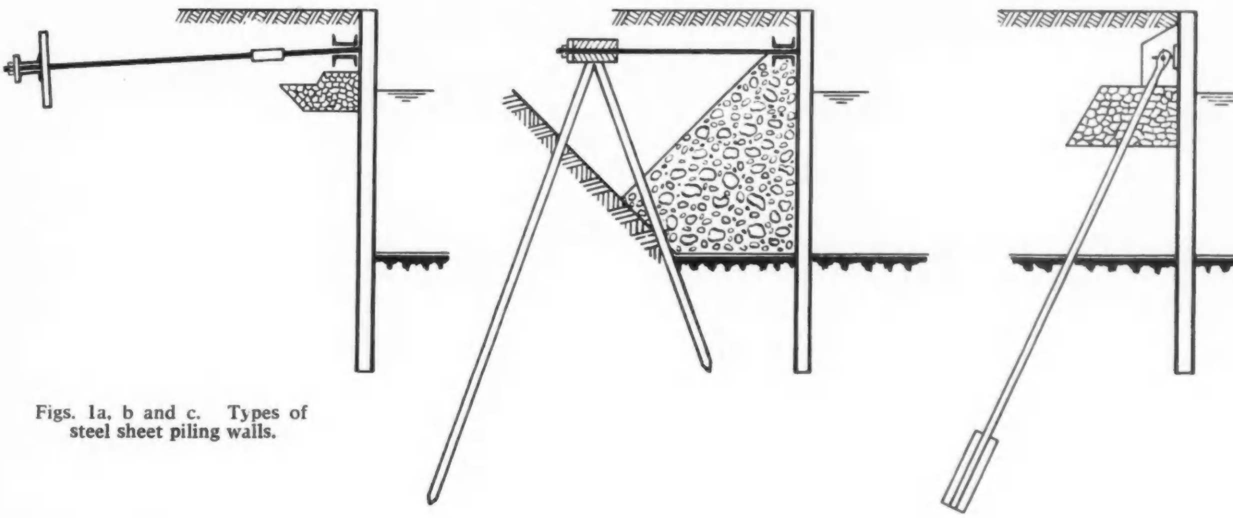
Typical Uses of Steel Sheet Piling

FOR works in which either earth or water masses are to be supported or retained, Steel Sheet Piling is ideally suited for the formation of walls and has the advantage of being strong, light and water-tight. Erection is extremely simple, the wall being formed by driving a series of identical piling sections into the ground, the elements being attached one to the other by means of interlocking jaws. Such works may be performed with the minimum requirement of materials, tools and time of preparation.

In building a jetty or quay wall bounded on one side by water, it is possible, subject to local conditions, to drive a wall of piling into the soil behind the shore line, as in Fig. 1a, or in the water in advance of the shore line, as in Figs. 1b and 1c. The requisite depth of water at the jetty or quay face can be attained by dredging (Fig. 1a) while the level of the quay decking behind the wall is established by the height of the back filling (Figs. 1b and 1c). The photograph (Fig. 2) shows a quay of this type completed and in use, while Fig. 3 shows a piling wall, complete and anchored, prior to filling.

Sheet piling is often used as an important part of certain types of constructions; it may, for instance, be driven either in front of or behind the decking of a quay wall supported on piles (Fig. 4) for the purpose of preventing any slippage or erosion of earth from the bank or to cut the flow of underground watercourses. It may also be inset in the bed of a lock or weir (Fig. 5) in or at the base of a dam, to either stop or limit any flow of water retained by the working and thus prevent any erosion of the undersoil.

Fig. 3. Dock wall at Horsens Havn, Denmark.



Figs. 1a, b and c. Types of steel sheet piling walls.

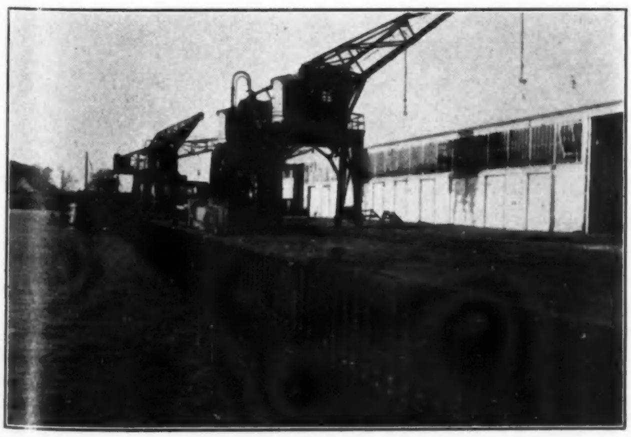


Fig. 2. Quay wall at Enschede harbour, Twenthekanalen, Holland.

The pressures exerted by earth or water upon a sheet piling wall are counter-balanced, firstly, by the reactions of the soil into which it has been driven and secondly, excepting for less important works, by the traction of an anchorage from the head of the piling at some distance below the earth fill or decking level. In cases such as that illustrated in Fig. 1a, the upper part of the piling wall is attached by round bars or steel cables buried in the earth fill, to concrete anchorage blocks, a buried wall of short steel piling sections or to trestle anchor piles. In Fig. 1b, the wall is fastened back to piles forming a trestle which function progressively as an anchorage as the earth fill behind the wall is raised. The anchorage piles may be box sections formed from sheet piling elements. Such piles, with suitable flanges at their

Modern Applications of Steel Sheet Piling—continued

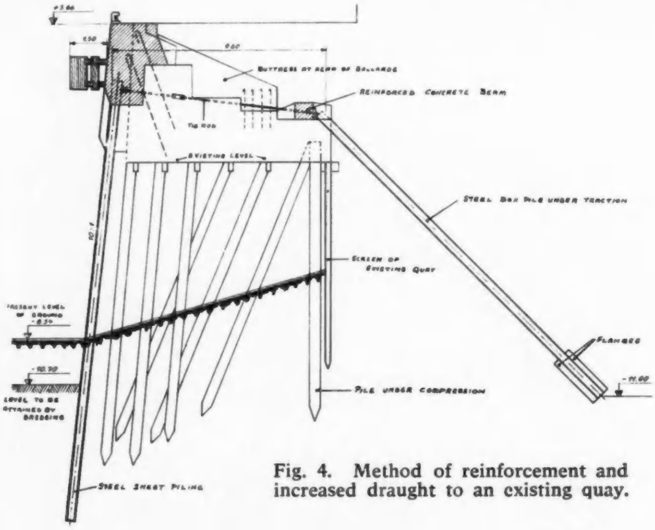


Fig. 4. Method of reinforcement and increased draught to an existing quay.

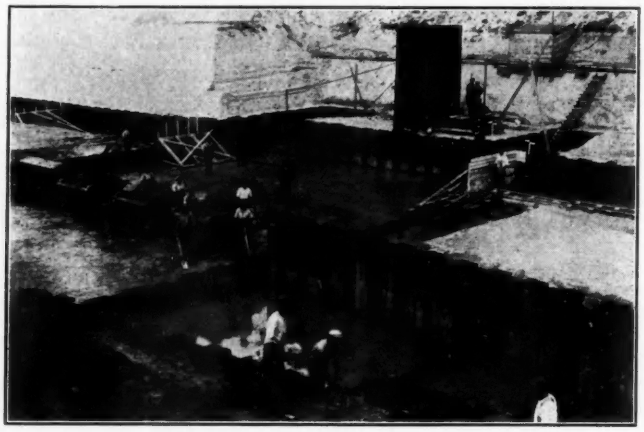


Fig. 5. Foundations of the lock at Denderbelle, Belgium.

bases to increase resistance to withdrawal, as shown in Fig 1c, may also be inserted into the sheet piling wall. In the case of works, such as those shown in Fig. 4, the head of the sheet piling wall is secured to solid blocks of masonry and the tractive forces applied to the anchorage are counter-balanced by the raked foundation piles.

Existing installations may be usefully reinforced by steel sheet piling, enabling their range of service to be extended very considerably. As an example, Fig. 4 shows a scheme in which a wall was originally constructed of piling driven behind a decking supported on raked foundation piles. In order that vessels of a greater draught might be accommodated, however, a new wall of steel sheet piling was driven in front of the existing construction thus permitting dredging to be undertaken to a greater depth. A simple trestle of piles was connected to the anchorage rods of which the section under tension was a steel box pile, to the lower extremities of which protruding flanges had been attached, thus increasing its natural resistance to withdrawal, while the section under compression was one of the original rear foundation piles.

In the case of many quays, which were severely damaged during hostilities, extensive use has been made of sheet piling to bring these again into use, the piling in these cases being driven as a wall along the face of the original quay.

Jetties, breakwaters and cofferdams may be formed (see Fig. 6) by two parallel walls of steel sheet piling. Tie rods, buried in the earth or sand filling, connect the two walls and ensure perfectly co-ordinated action between them. Employed in this manner there is not, as in the case of a single wall, any necessity for exterior strutting or anchorage of the piling.

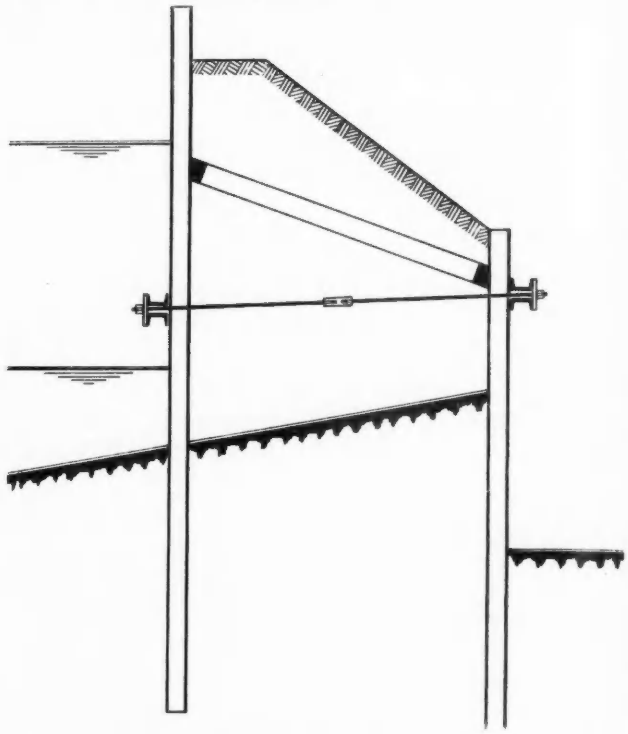


Fig. 6. Cofferdam formed of two walls of steel sheet piling.

In the case of a totally enclosed cofferdam, where excavation and construction work in dry conditions are to be undertaken, the resistance of the sheet piling to exterior forces is ensured by shoring and a braced framework (Fig. 7).

Steel sheet piling is also a means of very economical construction of heavy free standing works. The salient characteristic of such structures is their ability to remain stable despite the action of forces tending to overturn them. Their stability arises from their own weight when filled with earth, which is the most economic and relatively heavy material.

Sheet piling of a special type, a flat section, is most suitable for the construction of circular cells (Fig. 8a) or a series of diaphragm cells, of which the exterior walls form arcs of a circle (Fig. 8b), which are filled with earth after erection. The width

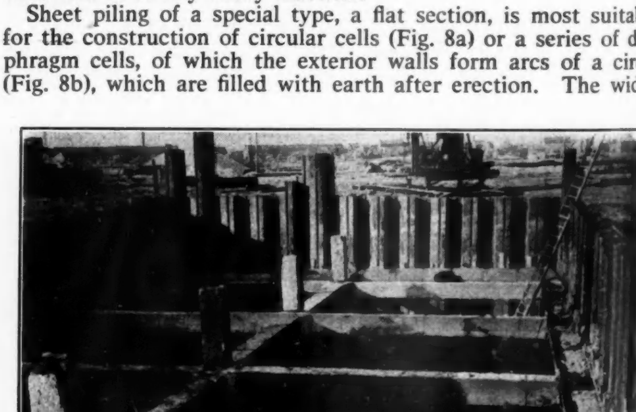


Fig. 7. Cofferdam at Comines, France.

Modern Applications of Steel Sheet Piling—continued

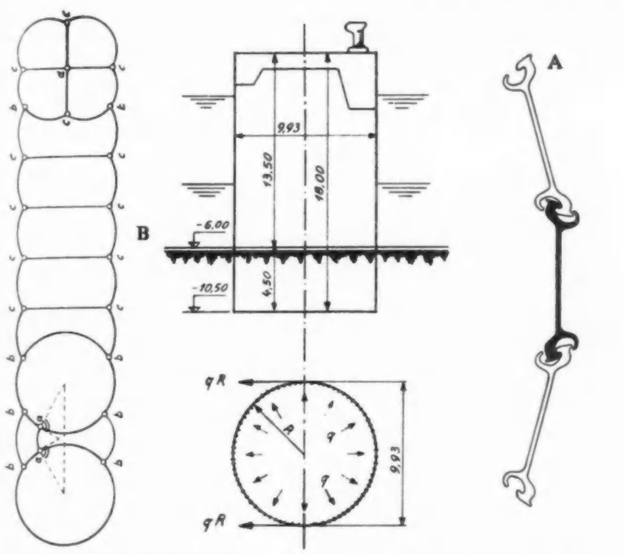


Fig. 8 (a and b). Cellular construction in flat steel sheet piling.

of such constructions is relatively large, being often of the ratio of .8 to 1.2 of the height of the mass of earth or water thus retained. In these conditions, the filling, which forms the core, is submitted to compression at all points, in all directions and thus works as a solid mass of concrete devoid of all tensile strength. The surrounding piling contains the earth fill and by reason of the circular form of its walls, the pressures applied to it develop principally as horizontal forces of traction perpendicular to the connecting jaws of the piling elements. The effects of vertical bending, which are a preponderant consideration in straight walls, are, in the case of circular walls of flat piling elements, only of secondary importance.

For such self-stable installations, there is no necessity for any exterior anchorage or any interior waling, the cells may be positioned on a flat rock base where driving of the piling is not possible. On the other hand, when the soil is suitable, they are driven, but the depth of penetration need be considerably less than would be the case of a straight wall erected for a similar purpose.

These cellular constructions, for which new forms of employment are multiplying rapidly, are being used in the construction of large cofferdams, quays, walls of dry docks, jetties and breakwaters. The illustration (Fig. 9) shows the end cells of a jetty head at the entrance to a ship canal in the course of being filled. A single isolated sand-filled circular cell, of the type shown in

Fig. 9. Jettyhead at Wintam, Maritime Canal of Brussels, Belgium.

Fig. 10, serving as a dolphin, is capable of withstanding the tractive efforts of the order of 100/150 tons in the case of ships of normal tonnage, or even up to 300 tons in the case of vessels of more exceptional size.

As in the case of practically all rolled steel sections, the elements of sheet piling may be assembled together to form more or less complicated shapes. It is, for example, possible from four typical sheet piling elements to make up box piles of the several shapes shown in Fig. 11. Such box piles are capable of supporting very considerable compression loads and when integrated as

Fig 10. Individual caisson of flat steel sheet piling serving as dolphin in front of the new docks at Schiedam, Holland.

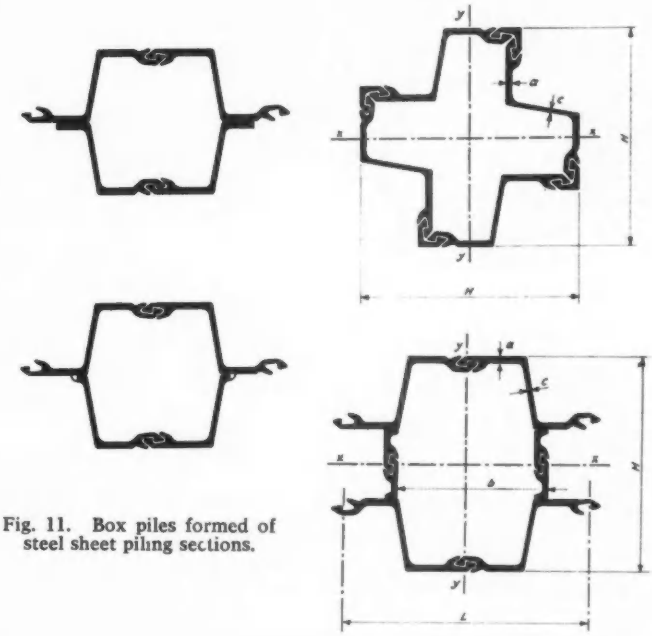


Fig. 11. Box piles formed of steel sheet piling sections.

a part of a normal sheet piling wall, they increase its strength and, at the same time, support heavy vertical loads, thus acting also as foundation piles.

Box sections of the type shown in Figs. 12 and 12a make relatively flexible piles which, when suitably connected and grouped, can form a supple dolphin capable of absorbing the impact shock of vessels by considerable horizontal deformation thereby reducing the force of impact on the hulls of the latter.

It is also possible, by using the normal piling sections, to produce, as shown in Fig. 13, what are in fact large hollow beams. These when driven to a sufficient depth and suitably filled, are capable of very high moments of resistance, as any relative move-

Modern Applications of Steel Sheet Piling—continued

ments in the vertical joints between the piling sections is prevented by one or two horizontal frameworks of bracing attached within the walls after driving has been completed. Such structures may serve as mooring dolphins (Fig. 14) relatively less flexible but making very solid points of support for vessels manœuvring. Where it is convenient to do so, it is possible for these structures to be built on shore and transported to the required position before driving.

Methods of Calculation

The methods of calculation employed are both numerous and varied. A number of empirical processes based solely upon the results of trials made on varying scales have been established, while there are as well systems which are based upon deductions drawn from reasoned theoretical considerations, which are analysed and revised periodically in the light of experience.

As an example of the considerations which come into question, let us assume the case of a piling wall SAB (Fig. 15) which is driven into the soil and is fitted with anchorage ties towards its head. The active pressure of earth and water bear upon its rear face throughout its height, whereas the passive pressure of the soil tends to wedge the driven portion.

The laws of variation of active soil pressures are always the subject of much discussion but it is generally admitted that Coulomb's theory, relating to sliding plane slopes, gives a fairly exact representation in this respect. The pressures, already

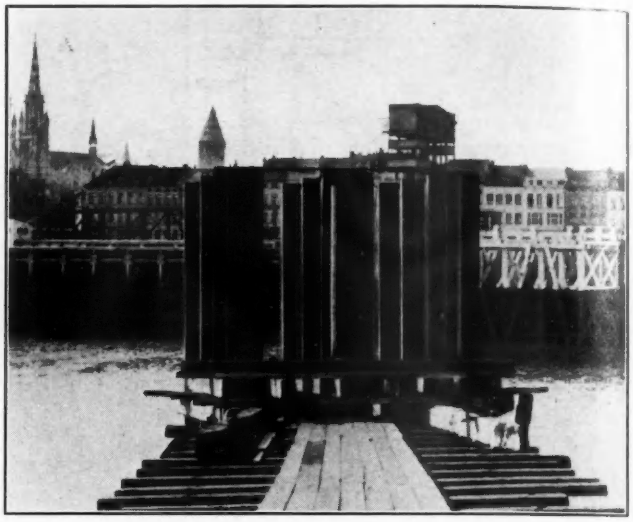


Fig. 12. Mooring station at Ostend harbour, Belgium.

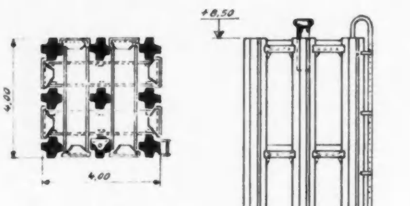


Fig. 12a. Mooring dolphin in Ostend Harbour, Belgium.

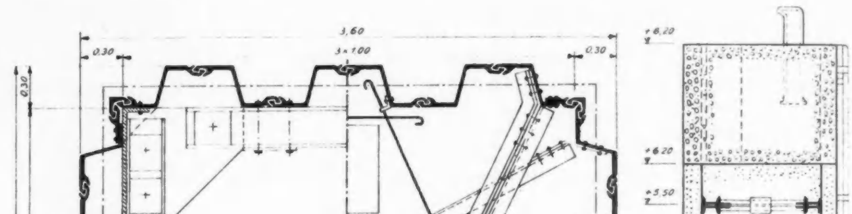


Fig. 13. Construction details of a dolphin in the entry channel of the ship lock at Zeebrugge.

mentioned in the previous paragraph, tend to bend the wall and the section AS, which is above the anchorage point, is thereby forced back, compressing the soil behind it. This produces in this soil a reaction, thus increasing the pressure that it already exerts upon the section AS, tending to raise it to the value of the passive soil pressure, notably greater than the active soil pressure (for example, at least 9 times greater in the case of soil which has a natural angle of slope of 30°). The increase of pressures upon the section AS has the effect of reducing the maximum bending moment of the wall over the section AB and to increase the traction exerted upon the anchorage tie rod.

This question has recently been analysed by Dr. Eng. Briske but it cannot be said that one can yet designate with any exactitude the values of the changes brought about in the stressing of the structure. It should also be noted that any relaxation of the tie rod, due, for example, to a movement of the anchorage, will diminish backward movement of the section AS and thus reduce the effects that have been mentioned.

The passive soil pressure upon the driven portion CB of the piling develops progressively as the soil against its outer face is pressed back over a greater distance. It does, however, attain its maximum and remains constant after this movement has passed a certain point, usually of the order of an inch or so.

The maximum ratio of passive soil pressure present at a given depth in soil of which the characteristics are determined may be considered as known, on condition that one rejects the clearly exaggerated values that are given to passive soil pressure by the Coulomb Law and other inexact hypotheses in cases where there are any considerable soil frictions exerted upon the wall in question.

Let us consider now (Fig. 16) the case of a wall of infinite rigidity, which does not undergo any deformation due to bending. The passive soil pressures on section CB can develop only if the soil is pressed back by a rotation of the wall about the point of anchorage A. The pressures increase proportionally to the amount of rotation, up to values represented by $C\beta_oB$ such that their moment about the point A equalises the moment of the active pressures. The ratio of passive soil pressure should be less than the available maximum, otherwise the structure would be destroyed under the least increase of active pressures.

Modern Applications of Steel Sheet Piling—continued

If one considers now the normal case of a flexible wall, it will be seen that the active pressures acb cause bending and the corresponding deformations of the driven portion CB are such that the passive soil pressures develop according to Rule $C\beta_1B$ of the available maximum. The moment of these passive soil pressures about the point A then becomes greater than the

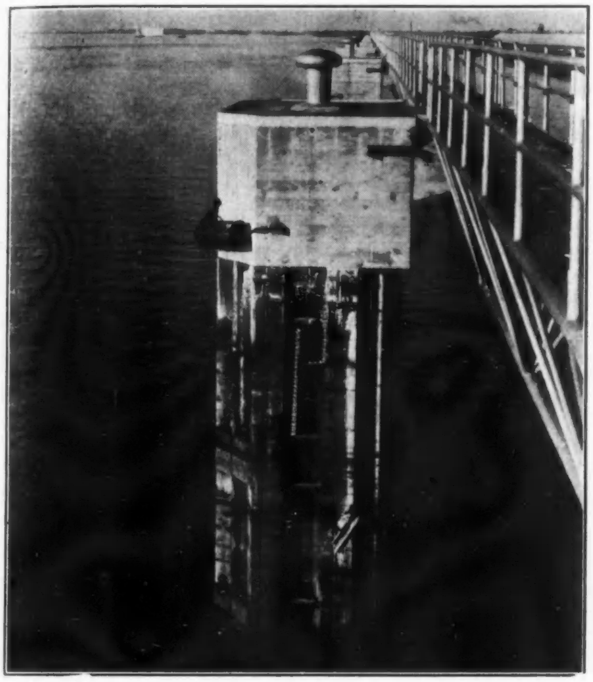


Fig. 14. Dolphin in the channel to the new maritime "Baudouin" lock at Antwerp, Belgium.

moment of the active pressures. The foot of the piling B, is pressed backwards and becomes wedged in its initial position. The stability of the wall re-establishes itself by the appearance of counter-reaction at the foot of the piling, which is of a maximum intensity $B\beta_2$, approximately equal to $B\beta_1$. It can be assumed that the reaction and counter-reaction follow Rectilinear Law, which, when plotted as $C\delta\beta_2$ gives the same moment about A as that of the active pressures. In making comparative study of the loads imposed in various cases, it can further be assumed that the counter-reactions concentrate in a single horizontal force Q′ applied to the lower extremity of the piling B.

In the case of the flexible wall, this counter-force Q′, and all the pressures applied to the wall, are known and we are thus able

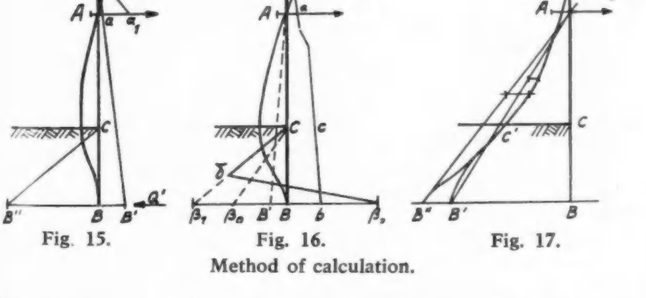


Fig. 15. Fig. 16. Fig. 17.

Method of calculation.

to plot the curve SC′ B′ (Fig. 17) of which the abscissas in relation to the vertical datum ACB represent the cumulative moments of active and passive soil pressures at varying heights. The wall is still stressed by the tension of the anchorage A and by the concentrated counter-reaction Q′. The total moment of stress has a known value at A, which cancels itself out at B, consequently the moments applied to a flexible wall are represented by the abscissa of the curve SC′ B′ related to the straight line AB′.

For a very rigid wall the passive soil pressure upon CB being reduced the points of the moments follow a curve SC′ B′′ which should be such that the moment and shearing effort are cancelled simultaneously at the foot of the piling (B), owing to the disappearance of the counter-reaction Q′. The arc of the curve C′ B′′ is, therefore, defined by the fact that its tangent at B′′ passes through the point A. The diagram Fig. 17 shows quite clearly that a rigid wall is subjected to a maximum bending moment and a tension upon the anchorage much greater than would be a flexible wall. These are in fact sometimes doubled.

The influence of the rigidity of a sheet piling wall upon its loading has been disclosed and calculated by trials conducted by Prof. Rowe. Analysis of the results and the measurements effected on large scale models and existing works shows that the normal sections of Z and U type steel sheet piling possess, in all normal conditions, sufficient flexibility to mobilise the maximum ratio of passive soil pressure. Their loading should, therefore, be calculated rationally upon the hypothesis that counter-reaction is present at the base of the sheet piling and by supposing maximum passive soil pressure to be available.

The method of calculation instituted by Blum some 30 years ago, meets the foregoing considerations and further fixes the depth to which the piling should be driven in order to overcome any angular deformation of the wall at its base B, that is to say, to ensure, as far as possible, it being properly embedded in the earth.

(To be continued)

Transportation by Pipeline

Some Comments on the Problems Involved

By A. C. HARTLEY, C.B.E., M.I.C.E., Hon.M.I.Mech.E.

An interesting paper on the use of pipelines as a method of transport was read before the Institute of Transport in London last November and extracts of particular interest to readers of this Journal are given below.

In his introductory remarks, the author pointed out that transportation by pipeline is at present mostly connected with crude oil and petroleum products including gas, particularly in countries where the crude oil and products are required at great distances from the sea or rivers where water transport can be used. The movement of solids by pipeline is, however, daily receiving more attention and it has therefore been thought worthy of mention.

In the Near and Middle East, apart from the necessity of getting oil to the Persian Gulf, major pipelines have been developed to enable oil to be loaded into ships at the Mediterranean coast and so avoid the longer haul by sea around Arabia and the payment of Suez Canal Dues.

With oil, there are batch methods of transport in road and rail tankers and in sea-going and coastwise barges and tankers. An important difference in batch transport is that the coast does not materially vary with the quantity to be handled because it merely means that a larger number of units is required. The cost of transportation by pipeline, on the other hand, drops rapidly with the quantity to be transported because each increase in diameter of pipeline raises the capacity much more rapidly than the cost of construction and operation. The capital cost of pipelines is relatively high owing to its static nature and the operating costs are relatively low. It follows, therefore, that optimum overall costs can be obtained only if the pipeline is operated continuously day and night at full capacity and that unit costs will rise very rapidly as the actual throughput falls below the maximum. It is also obvious that, once a pipeline is laid, it is not possible to change its destination and a pipeline system is therefore very inflexible as compared with batch transportation methods.

Transportation by Pipeline—continued

When it has been decided to go ahead with a project, the route must be carefully surveyed to determine what are the natural obstacles to be crossed and the general direction of the line. The pumping of a specified quantity of a given oil over a given distance may be achieved by larger-diameter lines with smaller pressure drop or smaller-diameter lines with greater pressure drops. A larger pipe line will involve higher capital cost and lower running costs and a smaller pipe smaller capital costs and higher running costs. An economical balance must be struck between these two alternatives and unfortunately no hard and fast rules can be laid down.

Pipelines for Transporting Solids

Solids may be conveyed by pipeline in suspension either in liquid or air. The first experiments in both hydraulic and pneumatic conveying were carried out almost a century ago yet the number of pipelines for conveying material by either method remains small.

One of the main applications of solids pipelines at the present time is in suction dredging with ancillary pump-ashore lines for reclamation or disposal purposes. Suction dredgers have been in use for more than 50 years, and although their operation would not compare economically with a commercial solids line, much can be learnt from experience in this field. Normally, for instance, the percentage concentration is kept very low because there is a danger of much higher concentrations occurring accidentally and these fluctuations have to be allowed for. Dredgers often have to deal with highly abrasive substances and special centrifugal pumps have been developed with rubber linings to lengthen impeller and volute life; even then a life of 12 months for the lining would be considered good. At the Aden Oil Harbour dredging contract nearly six million yards of sand and shells were pumped ashore for reclamation through 26-in. diameter pipes, the quantity of sand pumped dropping considerably when the length of pipe exceeded 3,000-ft.

In the case of the suction dredger the solids pass through the pump, but considerable work has been done in developing a technique for introducing the solids into the system after pumping. This is done by releasing medium to atmospheric pressure at the same rate by volume as the solids are fed in. The displaced medium is then repumped into the system.

Pneumatic conveying of solids differs from hydraulic conveying largely in the much greater ratio of densities between transporting medium and solids. The mechanism of transportation is essentially the same. Power requirements are considerably greater and abrasion of bends and fittings by hard materials increased.

This method of conveying is widely used for short distances in the transport of cement, ash, grain, pulverised coal, dust, flour, etc. The performance and capacity of a conveying system cannot always be predetermined accurately, but experience has given a background for prediction. Pneumatic handling methods have been in use for almost a century.

Sea Lines

Sea-loading lines for pipelines have, from the earliest days of the industry, been laid along the sea bed to continue the land pipelines into sufficient depth of water for loading tankers. In 1934, 12-in. lines were laid at Haifa and at Tripoli for loading the Iraq Petroleum Company's oil. These lines were of ½-in. wall thickness and had negative buoyancy when in the water. The method adopted was to weld the pipe on a specially prepared track straight inshore from the line and place it on small tracks. Divers then walked the sea bed to be certain there were no obstructions and wire lines were then brought inshore from a tanker fitted with a special towing winch. When all was ready, the tanker steamed away from the shore, graduating the pull on the pipe to the required amount by paying out or winding in the wire line on the winch, the object being to maintain a steady uniform pull on the pipe.

Many lines were laid by this method, but other means had to be used when it became necessary to lay larger diameter pipes which would not have natural negative buoyancy. Protective coatings have been developed for protection against corrosion and also for adjusting the weight of the pipe to give the desired degree of negative buoyancy. Projects are at the moment under active development which will involve laying sea lines about 20 miles in length and consideration is being given to the use of special methods which have been developed during the past few years. One method is to use what is termed a "lay" barge designed to provide facilities for lining up, welding, X-raying, completing the coating, and lowering the pipe to the sea bed in a continuous operation. These barges are of considerable size and their movement along the line of the pipeline is controlled by anchors and guy lines from the corners of the barge, forward movement being accomplished by the use of winches and the anchor lines. Very considerable care has to be exercised not to overstress the pipe when operating in deep water and also particularly in rough water. Another method which has been successfully used is to weld the pipe continuously on the shore and pull it along the sea bed. It has been shown that if the weight of the pipe is correctly controlled having regard to the specific gravity of the mud on the sea bottom, lengths of very many miles can be pulled by a winch on a barge, which is secured on the line of the pull at various stages by wire ropes previously laid and anchored a considerable distance beyond the end of the pipeline.

Tanker Loading

Tankers are loaded either alongside piers or docks built sufficiently far out to sea to give the required depth which may be up to 65-ft. at low water, or moored at sea lines by their own anchors and buoys. With piers or docks, pipelines of the required capacity are laid on the approach or in the water, and terminate in suitable flanged connections on the deck of the pier or dock. Flexible hoses of the required size and number are connected to the ship to permit loading rates as requested and they may be in excess of 5,000 tons an hour. Mechanical gear is now being installed to handle the hoses and adjust them, in some cases automatically, to allow for the rise and fall of the tanker relative to the deck of the pier or dock due to rise or fall of the tide and the loading or unloading of the tanker. Schemes are being developed to replace the hoses by steel pipe and mechanical joints.

With buoy mooring berths, one—or in some instances more than one flexible hose about 220-ft. long is connected at one end to the sea loading line near the tanker and coiled on the sea bed with the other end attached to a chain marked by a buoy. The buoy chain and hose are connected to the tanker's manifold system. The hoses are of extra heavy construction to withstand damage on the sea bed and hoses of larger than 10-in. diameter have been found to be very difficult to lift and connect. It has also been found difficult to handle more than one hose because of risk of damage by entanglement, which is serious because of their great cost. In practice the loading rate of tankers at buoy mooring berths has therefore been very much lower than at piers because of the restriction causing high velocity of flow in the hose and large pressure drop.

A device called a "hoister" has been designed and after successful model scale tests, is being installed for trials at a buoy mooring berth. The principle upon which the hoister acts is to lift the connecting hose from the sea bed by means of buoyancy. To achieve this, the main part of the flexible hose is replaced by solid pipe to which is connected a container which, when emptied of water by air pressure, lifts one end of the pipe to deck level, the other end being anchored to the sea bed. In this position, the remaining parts of the hose act as a flexible connection between the sea line and the hoister at the bottom and between the hoister and the tanker at the top.

The hoister can be designed to handle the number and diameter of flexible hoses necessary to allow unrestricted flow through the sea lines, and may also be designed to handle simultaneously more than one product when more than one sea line is in use.

In conclusion Mr. Hartley said that in spite of temporary falling off from time to time in the demand for oil, it is quite clear that in the long term, the demand will grow at an ever-increasing rate and many large pipeline projects will have to be undertaken which will offer wide and interesting fields for the activities of all those interested in this means of transportation.

A New Type of Ship's Gear

Design with Attributes of a Shore Crane

By Th. STEENSMA (Transport Consultant).

Despatch, turn-round, output . . . what familiar terms to everyone in the shipping industry. How much attention has been paid to the problems of faster despatch, quicker turn-round and higher output by many organisations and in meetings of interested parties, such as naval architects, shipbuilders, shipowners and all those on the waterfront directly connected with the loading and discharging of vessels.

Yet the international shipowner, for whose benefit all these meetings are held, papers written and opinions exchanged, has little reason to be satisfied. His ships are faster propelled, more streamlined than those he owned one or two decades ago, but when confronted with the present day facts and figures of the cost of turn-round of his vessels, the calendar sometimes appears to be running against time. Slower despatch, higher stevedoring costs and lower output have to be faced in many of the formerly "fast ports," swallowing up to 35 per cent. of the vessel's freight revenue and reducing the number of voyages.

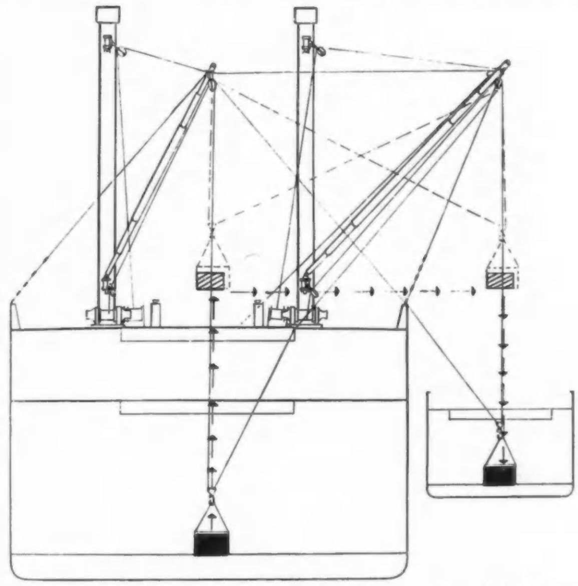


Fig. 1. Conventional system which offers no flexibility and requires two winches, four guys and preventers.

In the July, 1958, issue of "The Dock and Harbour Authority" considerable attention was given to the controversy between modern quay cranes and ships' gear and the relative merits of the two kinds of equipment were discussed, mainly from a British viewpoint.

Taking a general picture of the cargo handling situation of to-day, it is easy to recognise the basic improvements such as "roll on—roll off," "lift on—lift off," containerisation, palletisation and other methods, all of which have been designed to lower cost and increase output. Such methods, however, can only be of assistance to a few specific services where, usually, large investments in money, coupled with an inevitable sacrifice of cubic space on board the ships, will as much as possible eliminate manual labour in stevedoring operations. However, the majority of general cargo vessels were not built for one specific service between two regular ports but were built to call at a number of ports or roadsteads where cargo can be loaded or discharged, landed on a wharf or dock, or loaded from barges or surfboats, and therefore in many cases these special cargo handling methods are not practicable.

On the whole, the shipowner has to accept what the shipbuilder can offer to satisfy the wishes of his masters and cargo superintendents. This, generally, is still the old ships' gear with derricks or booms, falls, guys, preventers and winches (Fig. 1). These are still far from perfect and in the past have caused many accidents.

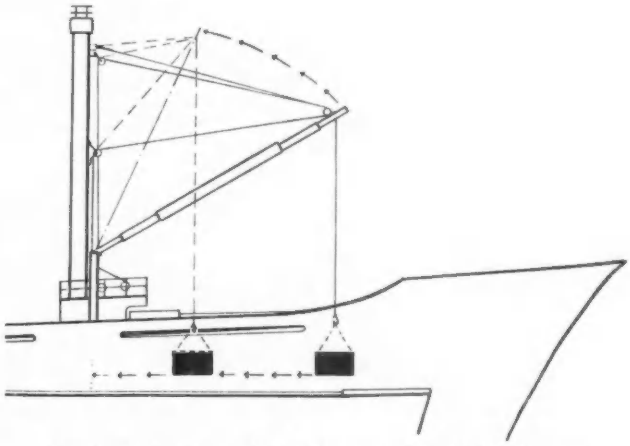


Fig. 2. Advantages of electric crane. Slingloads of cargo can be placed wherever required, in the square of the hatch.

Definite improvement has been effected by the introduction of the modern deck crane. Even so, in some instances, the deck crane barely reaches into the hatchway or over the side, which results in just as much dragging, pushing and trimming of cargo as the conventional ships' gear requires, even though it usually works faster and needs only one attendant. This is an unpopular equipment with the stevedore and, together with time required to "spot the load," makes the method costly and slow. It compares unfavourably with the performance of the modern shore crane which can accurately place the sling load wherever wanted in the hatch, ashore or in a barge without further trimming or dragging about and, therefore greatly reduces the unproductive time of the stevedores.

Ideally, the shipowner should possess a ship's gear that offers the advantages of an electric quay crane (Fig. 2). This must reach well over the side and into the far corners of even the most spacious hatchway, yet it should be of simple construction that it can be operated by winchmen throughout the world's ports and roadsteads without any previous tuition or special skill. This sounds an almost impossible attainment; yet a solution has now been evolved and is incorporated in a new cargo gear (Fig. 3) which has been patented in Holland.

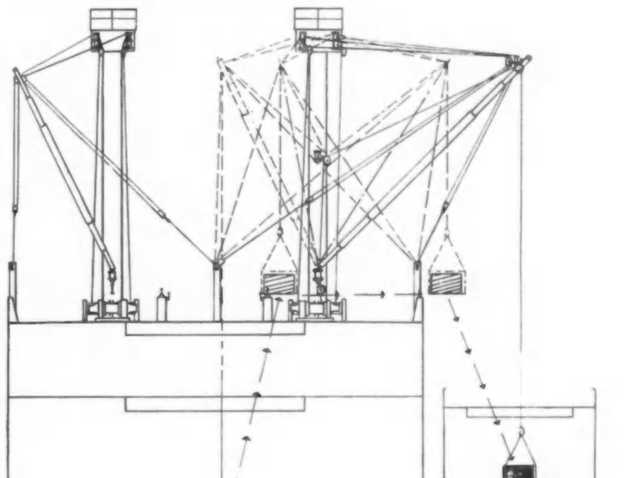


Fig. 3. The new system which offers great flexibility and incorporates many advantages. One winch, no stays, no preventers.

A New Type of Ship's Gear—continued

It should here be emphasised that this gear neither can nor will substitute a modern 100-ft. crane, as used in West European ports and which can reach across a seagoing vessel and across one, sometimes two large Rhine barges into the next barge lying alongside. These barges carry between 800 and 1,000 d.w. tons of cargo.

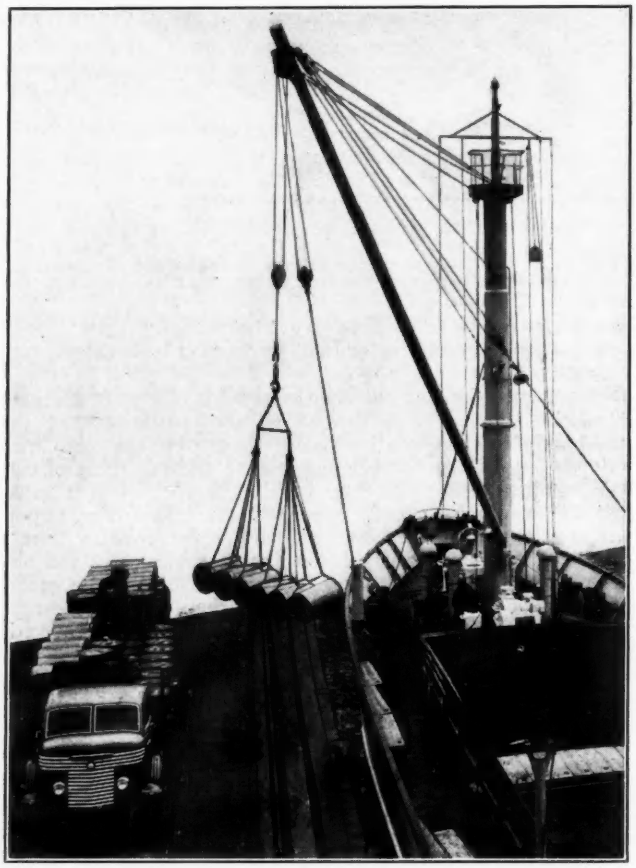


Fig. 4. The new system delivering cargo exactly where wanted.

It is obvious that no ships' gear could be expected to perform such extra duties. The largest Rhine barge afloat will take no less than 4,200 d.w. tons of cargo and in length and beam is often larger than the seagoing vessels. With smaller barges and inland water craft, however, the situation is entirely in favour of this newly developed invention, a description of which is given below.

The accompanying photograph (Fig. 4) shows the new system adopted on board the Dutch coasting vessel m.v. " Nassauhaven," which is the first seagoing vessel to be equipped with this type of gear. The ship operates in the Sont Line between Rotterdam/Amsterdam and Danish and South Swedish ports.

The Cargo Handling Gear

The principle characteristics of the gear are that the guys and topping lifts are combined. Two luff tackles are fitted to the derrick, of which the hauling part of each is led to a different drum of one (dual) winch: the topping-slewing winch. This instrument is operated by one handle only (the top lever in the winchman's left hand, Fig. 5). The drums of the winch can rotate parallel resulting in topping or lowering the derrick, when the lever is moved straight forward or straight backward. The drums can rotate in opposite directions, the boom swinging to port or to starboard on movement of the lever in that direction.

The lower lever (operated by the winchman's right hand, Fig. 5) controls the cargo fall. Moving the lever forward will hoist the load, moving the lever backward will lower it.

The derrick lever offers four positions: topping, lowering, slewing to port or to starboard, with speeds of up to 150 ft./min. The load lever gives two positions, hoisting and lowering with speeds to a maximum 350 ft./min. These speeds correspond well with those of the latest modern luffing cranes.

Both winches can be operated simultaneously, consequently a load can be hoisted or lowered as it is being swung to either port or starboard. Easy " spotting " or " plumbing " a load to wherever wanted, on a quay, in a hatchway or in a barge or lighter, is at the winchman's command and all the movements of the modern quay crane can be copied except, of course, the riding along its track.

An advantage of this gear is that any winchman in any port can immediately operate it without prior knowledge of the controls. There is only one controller, which can move the cargo at a much better speed than the conventional type derricks and winches which need two men to operate—after time wasted in rigging. As soon as the current on deck is switched on, this new gear is ready to work and there is no cumbersome rigging required.

The Winches

The topping/slewing winch is provided with two drums driven by one D.C. motor, whilst lamellar couplings in the gearbox enable the drums to rotate parallel or opposite.

The cargo winch, also driven by one D.C. motor on cast iron gearboxes, has special disc brakes activated by springs and released by electric magnetic coils. All the equipment is designed to withstand severe conditions, not only at sea when at rest, but particularly when in use in ports and roadsteads.

Severe tests undertaken by the Netherlands Harbour Safety Inspection have shown the gear to possess ample reserves, considerably more than required by marine classification bureaux and Board of Trade requirements in overseas' ports.

Fig. 5. The winchman operating the controls—a one-man job.

The Derricks and Guys

The patented rigging arrangement, which complements the special topping/slewing gear, is clearly shown in Fig. 4. The cargo fall is led through a block which is in the top of the derrick, to a guide block half-way down the mast and, from there, through

A New Type of Ship's Gear—continued

a second guide block to the cargo winch. These guide blocks are of a special alloy. The rigging of the guys, each of which acts as a half topper, has been explained above.

The entire arrangement is notable for its simplicity, ease of maintenance and of supervision and operation.

Advantages of the New Gear

The derricks can be raised and lowered in a fraction of the time required for the conventional ships' gear.

When loading or discharging timber, the vessel's trim usually needs to be watched, but with this gear work may proceed even with a list.

Erecting four derricks and four winches to one hatchway is a luxury, the new gear is therefore far faster than the old type. One winchman can handle loads up to 3, 6 and 10 tons by himself without even the need to change the spanguy.

Mechanically operated hatchways are unnecessary in ships equipped with this new gear. The common "pontoons" are taken off or replaced in a matter of minutes. Rain tents or strongbacks can be swiftly placed or removed. There is a considerable saving on wire and falls, since this new gear employs neither manilla nor shackles. The special alloy blocks do not damage the wire. All loads can be handled with the easily accessible 2 or 3 ton winches.

All these advantages render a most appreciable saving in port time and cost. General cargo is handled at rates of up to 35 tons per gang-hour by smaller stevedore gangs. Finally, this gear reduces the necessity to trim, push or drag cargo, which not only results in faster working but also in savings in cargo claims, whilst the danger of accidents is appreciably reduced.

Nigerian Ports Authority

Excerpts from Third Annual Report

The report for the year ended 31st March 1958, states that the year under review presented the Authority with the severest test of its economic stability since its inception in 1955. Like many other facets of Nigerian economy the Authority is at present dependent—probably over-dependent—on produce and the relatively small 1956 groundnut and cotton crops, followed by a poor cocoa yield in 1957, adversely affected its income. Nevertheless, some of the deficiency was made good by additional traffic attracted over the quays and the warehousing facilities provided since 1955. The latter, however, still fall far short of what is needed to steady its revenue.

It is characteristic of the ports industry generally that a falling off in transit traffic is often offset by an increase in warehousing business. It may be said, in fact, that the great ports of the world maintain an even path through the inevitable ups and downs of the sensitive shipping industry because of their warehousing activities which, in turn, serve to develop an entrepot trade.

The Authority is fully alive to the need and during recent years a 15,000-ton capacity warehouse has been constructed at Apapa Quay, another of like dimensions is in process of building at Port Harbour Quay, and an order was recently placed for yet a third at Apapa Quay. Still more are wanted and depend upon the availability of capital.

On 1st October 1957 the Authority, at the request of all interested parties, took over the operation of Customs Quay, Lagos. Under this arrangement the Authority takes delivery from ship at hook, places to stack and then delivers. In other words it now carries out all quay operations from ship's side to delivery to land or water conveyance. Previously the shipping companies delivered from hook to stack, and each individual importer made his own arrangements, including provision of labour, for delivery from stack. Customs quay is used to a large extent by small importers and the old arrangement contributed greatly to the unsatisfactory conditions which brought about the request for the Authority to take over.

The changeover was an immediate success, and whilst much credit is due to the Authority's staff, tribute must also be paid to the users of the port, particularly the small African importers, for the co-operation given. The manning of the quay with over 500 personnel of various grades involving considerable training, severely taxed the Authority's personnel resources as did the provision of the necessary traffic and other officers.

The reclamation of the areas above and below Customs Quay has been largely completed, and the way is now clear to provide a road running through the quay for its full length, thus reducing the number of gates from six to two. This work is proceeding and when completed, in addition to improving security, should play a part in decreasing traffic congestion on the main Marina road.

Navigational aids necessary for the night movement of ships were installed at considerable expense to the Authority. A full night pilotage service was introduced but the use made of this service to date is disappointing. Manning the service is costly but it is hoped that as time goes on greater advantage will be taken by ship owners of the opportunity to arrive and sail during the hours of darkness. Where it has been used it has proved a success and the Authority hopes that eventually the cost of introducing this modern facility will prove worthwhile.

Security arrangements have been progressively made and will continue to be pressed until a satisfactory standard has been achieved. The Police Force has been increased at all stations, and two fast security launches, equipped with powerful lighting, have been placed on order. Lighting in all installations has been improved and an experienced Fire Officer has been recruited.

The Port Harcourt extension was reported to be proceeding satisfactorily and it is hoped that the first two berths with transit sheds and road and rail access will be available by January 1960. As soon as these berths are in use, it is proposed to shut down one old berth at a time, not only to facilitate joining up the old area with the new, but also so that the necessary rehabilitation of the old berths may commence. The cost of this latter work is likely to be heavy, but it is becoming increasingly apparent that a critical stage is likely to be reached unless this work, long overdue, is put in hand within the next two years.

Schemes for training Nigerians, both in the United Kingdom and in Nigeria, for posts of higher responsibility including professional and technical grades have been stepped up progressively. The field includes management, traffic, navigation, civil and marine engineering, accounting, estate management, personnel and secretarial training. The Authority has received considerable assistance from outside Nigeria including shipping companies and port authorities in the United Kingdom to whom grateful acknowledgement is made. During the year the quality of Nigerian candidates offering themselves for appointment has shown a noticeable improvement and a number of direct appointments have been made. The Authority's training school located in the Apapa Dockyard has been enlarged and the number of employees of all grades passing through the school is increasing.

The final accounts for the year show a net surplus of £181,018.

Panama Canal Improvements

The Panama Canal Company are inviting tenders for the widening of the channel in the Paraiso and Cucaracha reaches in Gaillard Cut from 300 to 500-ft. at bottom depth. The work, which will represent the largest single excavation contract undertaken in the Canal Zone since the canal was opened, with the exception of the Third Locks project, is expected to take more than two years to complete and will cost some $12 million. Between 6,000,000 and 7,000,000 cu. yds. of rock and earth will have to be removed. The widening constitutes one of the principal projects of the short range improvement plan which was approved by the board of directors in 1957. Since then, work has been in progress on two other phases of this programme, which is designed to increase the transit capacity of the canal by 25 per cent. On completion, the new widening project will provide a channel 500-ft. wide for approximately half the length of Gaillard Cut. This will give ample clearance for all ships which can be accommodated by the locks to meet and pass anywhere in the channel, except for about four miles at the north end of Gaillard Cut. The bottom depth of the canal will be deepened by 8-ft. during excavation in order to facilitate future improvements.

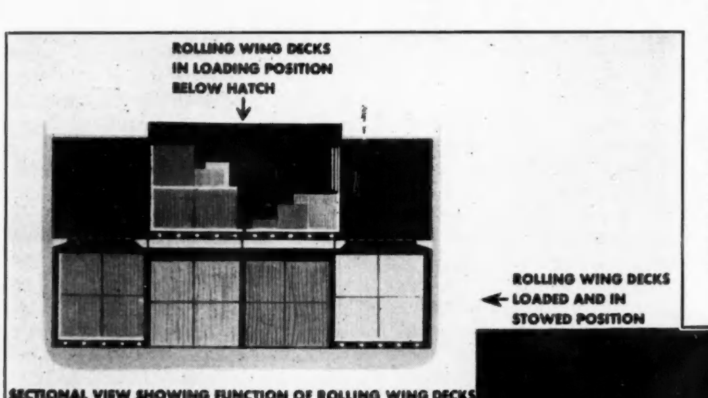
A Multi-Purpose Cargo Vessel

Designed to Handle Cargo in Bulk, on Pallets, in Containers and in Vehicles

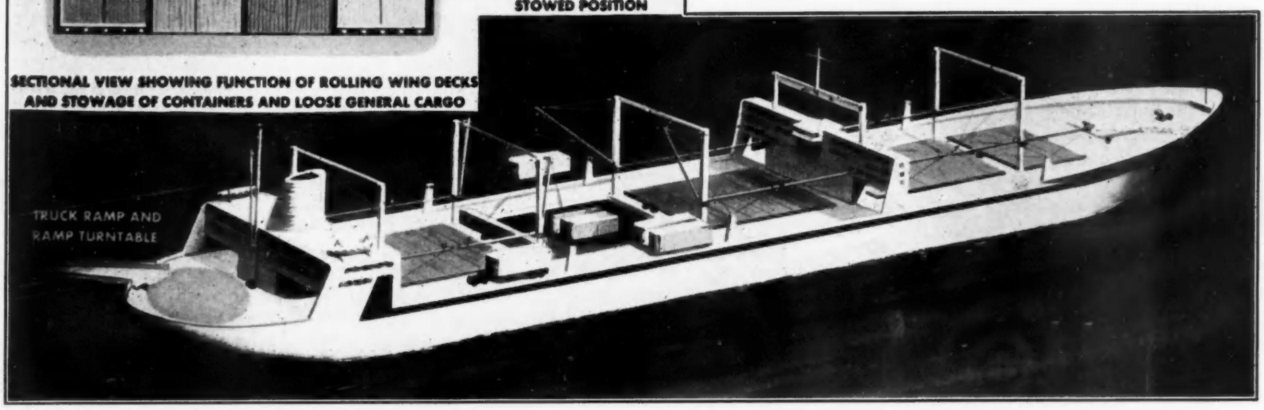
Farrell Marine Devices Inc. of Washington, U.S.A., announce that ships now in the design stage will soon be sailing with revolutionary features to accommodate the increasing trend to integrated freight — combining the best features for handling roll-on, roll-off traffic, goods on pallets and in containers and also loose and bulk cargoes.

It is claimed the new vessels will look quite different from any ship now afloat. The first noticeable unusual feature will be the clear decks created by tunnelling through the superstructure to allow an uninterrupted flow of trucks over the full length of the weather decks, thereby eliminating carbon monoxide problems encountered with motor trucks operation inside ships.

The second feature is the large turntable at the stern of the vessel, used to position the two-way ramp quickly on either side of the vessel to provide easy access for trucks from the dock to the vessel. This feature actually turns the ship's weather deck into an extended pier apron—to accommodate shedded piers with narrow aprons. There are many such piers in New York, Philadelphia, Baltimore, Boston, New Orleans, San Francisco and many other ports which are now considered obsolete for handling container traffic.



SECTIONAL VIEW SHOWING FUNCTION OF ROLLING WING DECKS AND STOWAGE OF CONTAINERS AND LOOSE GENERAL CARGO



The multi-purpose vessel will solve the problem of modernisation of piers with narrow aprons at little cost. This can be done by simply widening a door in the shed wall on each side of the entrance of the pier to receive the ship's ramp. Vehicles can then be driven from the street directly to the ship's deck to load or unload containers without disturbing loose general cargo handling on the pier.

It is further claimed that the continuous flow of trucks aboard on one side of the weather deck, delivering containers directly to the hatches and driving off on the other side, puts cargo handling on a rolling line basis. This operation will cut the travelling distance of the ship's cargo hooks by 50 per cent. and avoid delays caused by listing or rolling of the ship when such heavy loads are lifted by booms extended over the pier. In this ship, 8 or 10 rigs evenly divided on each side of the ship will be loading or unloading containers at the same time. Simultaneously with the rolling of trucks on the decks, truck containers up to 25 tons are lifted into the hatches by the flexible Farrell Improved Burtoning Cargo Gear with positive load control in a swinging boom operation at the speed and efficiency it has established in handling light loads. Its flexibility permits the speedy marrying of four 25-ton booms at all double-rigged hatches for lifting units up to 100 tons, such as locomotives and loaded military over-the-beach landing craft, thereby eliminating cumbersome jumbo booms. This gear was installed on the U.S. Navy's Roll-on/Roll-off ship "Comet" to lift vehicles on and off when they could not be rolled on and off.

An unusual feature of the new vessel, an illustration of which appears below, is the co-ordinated and counterbalanced Rolling Wing Decks which replace the stationary wing decks inside the ship. This, the Farrell organisation claims, was the first major step toward automation in marine transportation. The combination of the Improved Burtoning Cargo Gear and the Rolling Wing Decks permits swift mechanical positioning of trucks, containers, palletised cargo, loose general or bulk cargo, inside the vessel as though it had no decks. When the Rolling Wing Decks are loaded in the square of the hatch they are then rolled into their stowed position in the wing recesses in 30 seconds, assuring a 50 per cent. reduction in conventional cargo handling time and cost with present facilities.

The conveyor type rollers supporting the Rolling Wing Decks at their ends only are countersunk in the transverse girders and are permanently chinked so that they cannot be blocked by debris or bulk cargo. The mechanism for automatically taking the load off the Rolling Wing Decks' rollers when they are in the loading and stowed positions prevents damage to the rollers by dropped loads or by dynamic forces caused by the rolling and pitching of the vessel at sea. These features make them as safe and dependable as the stationary wing decks they have replaced.

The number of compartments in this vessel can be doubled by subdividing its cargo holds horizontally. This feature, together with a cargo of buoyant, watertight cargo containers specially designed to withstand the pressure in a flooded compartment, "will make it unsinkable."

This novel vessel was designed by Capt. V. C. Farrell, winner of the 1950 National Transportation Award (U.S.A.) for his invention of the rolling wing decks.

Port of Lisbon Trade in 1957

According to the recently published Bulletin of the Port of Lisbon, over 6,000 ships visited the port during 1957, totalling more than 16 m. tons gross and the total revenue, at 123,000 contos (approximately £1½ m.), was a record for the port. Cargo entering or leaving the port totalled 5,442,309 tons, as against 5,369,899 tons in 1956. Traffic of the port is 96% ocean-going and ships in this category numbered 3,726; there were 859 coastwise trading vessels and 1,469 fishing vessels. Passengers arriving at the port numbered 282,784 compared with 260,000 in the previous year.

The Port of Baton Rouge

Louisiana's New Ocean-River Port*

By JOHN D. M. LUTTMAN-JOHNSON, M. ASCE
(Senior Engineer, Fay, Spofford & Thorndike, Inc., Boston, Mass.)

AT the head of deep-water navigation on the Mississippi River, some 225 miles inland from its mouth, a new ocean-river port has recently been completed at Baton Rouge, capital of Louisiana. This initial stage of a $50,000,000 long-range development programme will provide the Baton Rouge area with modern port facilities capable of accommodating deep-water vessels and river barges. Its ability to transfer large volumes of liquid, bulk, and packaged goods between barge and ship, or to storage, is already changing transportation patterns in the South.

These facilities are not only modern in design but also extensive. They include a large general cargo dock with a frontage of 1,355-ft.; a central transit shed 625 by 200-ft.; a 2½-million-bushel grain elevator and ship loading dock, complete with conveyors and grain handling equipment; an 8-million-gallon molasses tank farm; a water supply system; supporting railroad tracks and yards, highways, and other appurtenances.

In March 1953, Fay Spofford & Thorndike, Inc., of Boston, Mass., and Barnard and Burk of Baton Rouge, were engaged by the newly created Greater Baton Rouge Port Commission to prepare a report and master plan covering the proposed development. During the succeeding 18 months, investigations were carried out and studies made of the many engineering and economic factors entering into the overall feasibility and planning of the project.

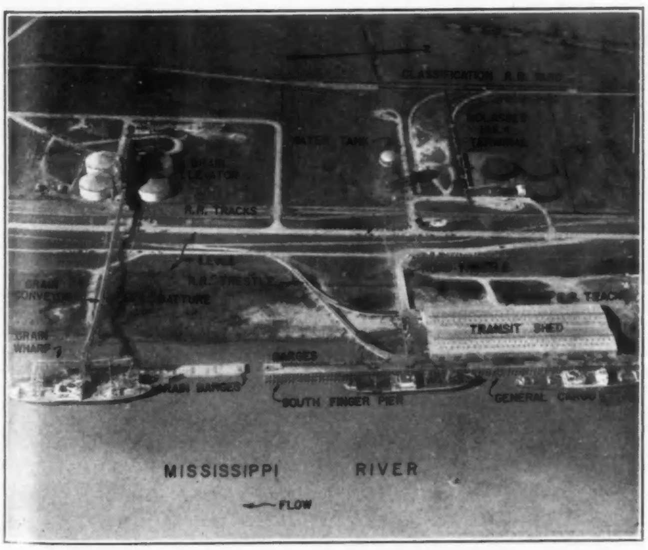
Site Selected

It was early determined that the best available site was on the west bank of the river immediately south of Port Allen, which lies across the river from downtown Baton Rouge. At this point the Mississippi is 2,000 to 2,500-ft. wide between levees and up to 70-ft. deep at Mean Low Water, which is 2.5-ft. above datum, or Mean Sea Level in the Gulf of Mexico. Tops of levees are at El. +50 minimum, while the maximum flood stage predicted is El. +46.50.

This site was selected for several reasons:

1. The land adjacent to the river was undeveloped pasture land

*Reproduced from the January 1958 issue of "Civil Engineering," the official magazine of the American Society of Civil Engineers.



Aerial view, looking west, of initial stage of port development at the head of deepwater navigation (35-ft. minimum) and some 225 miles inland from the Gulf of Mexico.

Aerial view, looking northeast, of new ocean-river port development on the west bank of the Mississippi, with downtown Baton Rouge and Capitol Building seen across the 2,300-ft. wide river.

and could be purchased at a relatively low cost.

2. The natural deep-water channel of the river lies close to the west bank, which is relatively stable.

3. Proximity to the proposed Indian Village-Port Allen Cutoff Canal of the Intracoastal Waterway would provide an opportunity to integrate the port and canal developments.

4. Three of the four trunk-line railroads now operating in the Baton Rouge area run close to the site.

5. Highway connections are good and their further improvement is planned.

6. Navigation conditions for ships and barges are favourable, and the large anchorage area has ample water depth even during minimum river stages.

Accordingly, the Commission purchased some 350 acres of pasture land at the selected site, with 6,000-ft. of deep-water frontage on the river. This area was laid out so that it was bounded on the west by Louisiana State Highway No. 168, on the north by the town of Port Allen, on the east by the Mississippi River, and on the south by the locks (now under construction) of the extension of the Plaquemine-Morgan City Alternate Route of the Intra-coastal Canal, commonly called the Indian Village-Port Allen Cutoff Canal. This location will make the new port a junction point for barge traffic on this section of the Inland Waterway System, which extends northward to Minneapolis and the Great Lakes, eastward to Florida and the Atlantic coast, and westward to the Mexican border.

Meanwhile topographical and hydrographical surveys of the selected site were carried out; test borings and soil analyses undertaken; engineering, layout and structural design problems studied; potential traffic and other sources of revenue investigated; methods of financing considered; and tentative operating agreements worked out with four railroads to service the port. In addition, a number of collateral engineering, economic, and operational problems attending the project were investigated and solutions formulated.

Apart from the work done in the Baton Rouge area, investigation and research on traffic potentials extended from New Orleans in the south to Minneapolis and Chicago in the north, to Kansas City in the west, and to Boston and New York in the east. Pros-

The Port of Baton Rouge—*continued*

pective lessees of bulk handling facilities were contacted and tentative agreements worked out for the operation of a grain elevator and a molasses tank farm. In September 1954, the master plan and report of the consulting engineers were published.

Initial Development

The report established the engineering and economic feasibility of a project covering an initial development on the west-bank site at an estimated cost of $12,500,000. Financing was to be through the sale of revenue bonds having a 40-year life and an assumed interest rate of 3½ per cent. However, when the bonds were placed on the market in October 1954, interest rates varying between 2.60 and 2.80 per cent. were obtained.

The extent of the initial development was determined after careful study of the many factors involved, such as traffic potential, leasing of special bulk-handling facilities, engineering problems, construction costs, potential operating revenues and expenditures, bond servicing, and other related matters. Features recommended for the initial construction and cargo handling equipment programme, their estimated costs, and the total financial requirements covering the first stage of development, are shown in Table I.

When the revenue bonds required to finance the project had been successfully sold, detailed contract drawings and specifications were prepared. Priority was given to the grain handling terminal and to roads, railroads, and water supply. By July, 1955, the grain elevator was in operation and handed over to the lessee, Cargill, Inc., of Minneapolis, Minn. By the middle of 1956, virtually all the remaining construction was either completed or nearing completion, with the exception of the transit shed, which was delayed by a shortage of steel. The shed has since been completed and is in continuous operation.

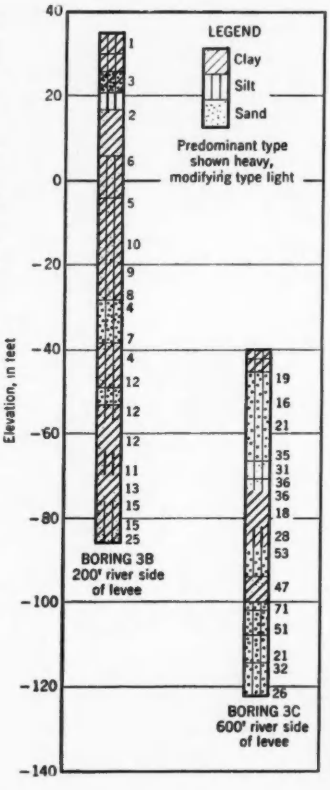


Fig. 1. Soil density varied widely along waterfront in vicinity of general cargo wharf, as shown by blow counts. Figures to right of borings indicate number of blows of 140-lb. hammer dropped 30-in. required to drive 2-in. split-spoon sampler 1-ft. after it had first been driven 6-in.

Actual construction and equipment costs have borne a notable similarity to the engineers' original estimates. This was the result of preparing a sufficient number of preliminary outline designs and of careful cost estimating in the report stage. In fact, because of the saving in bond interest, it was possible to add to the programme an Administration Building for the Commission at a cost of $115,000. Port operations and traffic to date are in line with overall predictions and should be further stimulated by the rapid industrial and economic growth of the region now under way.

Waterfront Problems

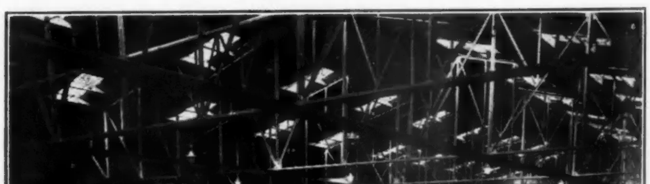
Engineering and design problems affecting the waterfront structures arose from both natural and man-made causes. Foundations had to be designed to suit the alluvial silts and clays of the area, deposited by the river over eons of time. Test borings to 120-ft. below Mean Low Water indicated alluvial deposits without any well defined stratification. Density by blow count varied widely, as indicated in Fig. 1. Lenses of relatively high resistance are underlain by softer or less dense materials.

Grain wharf with grain ship being loaded with export cargo. River barges berth on shore side of wharf and discharge grain through a marine leg to conveyor leading to grain elevator located on landside of river levee some 850-ft. distant. River batture seen at right.

On the protecting levee, 20-ft. high and 200-ft. wide at the base, regulations prohibited the use of piling or other construction that would require penetration of the soil. Railroad tracks and highway connections to waterfront structures had to cross the top of the levee at right angles to its axis—or as nearly so as practicable.

Regulations also prohibited any impediment to river flow in the land area (batture) between the levee and the low-water channel of the river, which is subject to flooding during higher stages. Consequently filled embankments to carry railroad and highway connections to the waterfront structures could not be used. Instead, trestles were built on bents made up of steel-pipe friction piles of 24 and 33-in. diameter, and varying in length from 124 to 145-ft. The reinforced concrete pile caps support 36-in. wide-flange steel girders, which carry the concrete decking. On the railroad connections, the trackwork is ballasted to simplify super-elevation on curves.

Fluctuations in river stages, ranging from Mean Low Water (El. 2.50) to the maximum predicted flood of 46.50-ft. above Mean

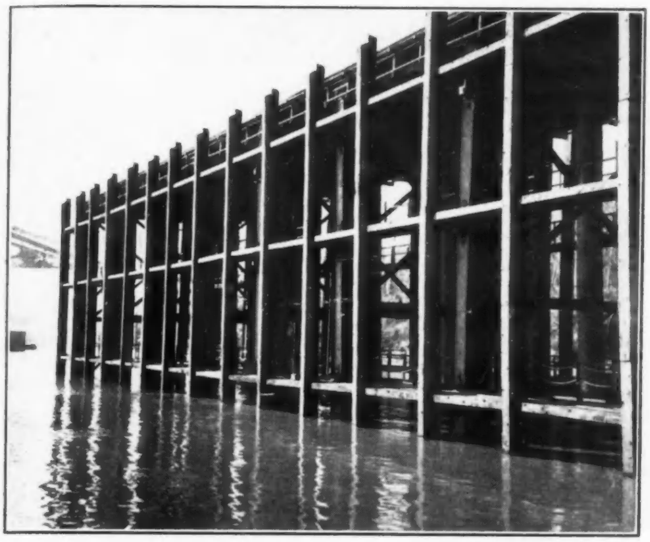


Interior view of general cargo transit shed, 625-ft. long by 200-ft. wide, with export cargo awaiting shipment.

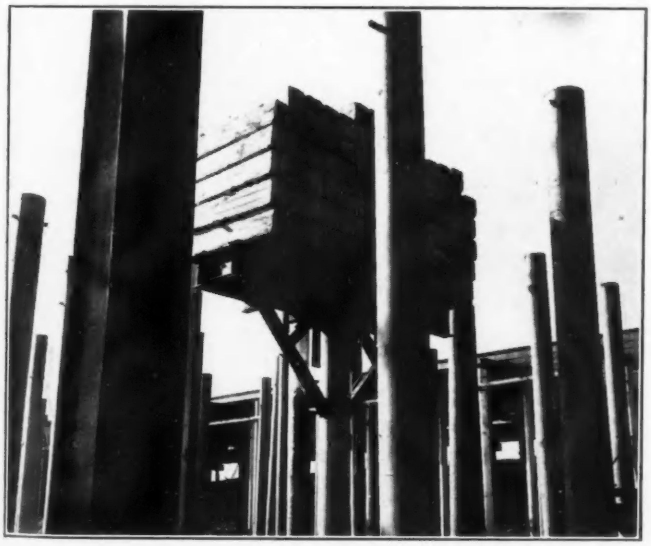
The Port of Baton Rouge—continued

Sea Level, required that the deck be at El. 52.5 for waterfront structures. With a Mean Low Water depth of roughly 35-ft. along the wharf faces, this meant that the top of the deck was about 85-ft. above the mud line.

Wharf structures were designed to withstand the horizontal forces due to ship impact in a lateral direction, as well as longitudinal forces due to water pressure on both ship and structure caused by the velocity of river currents which attain a speed of about 4 knots at higher stages. At the same time, it was important to provide a relatively open substructure to permit the passage of driftwood. To accomplish this aim, the general cargo wharf was designed so as to eliminate all lateral bracing in the substructure except for the north and south finger piers (extensions of the wharf apron), which presented a relatively small area to river flow. These factors, together with the functional deck loads, called for an unusually heavy type of construction, including a specially designed flexible fender system having a working face some 55-ft. high



Flexible fender system, 55-ft. high, at downstream end of South Finger Pier of general cargo wharf. Greenheart timber used on wearing face, and rubber at points of bearing.



Pile load bearing test at general cargo wharf with test load of 400 tons. In the case of Pile No. 35 J having a length of 152-ft. and 33-in. OD, the maximum settlement was 0.95-in. and the net settlement 0.25-in. Pile in foreground consists of two 30 WF 108 and one 36 WF 150 welded together to form a super H-pile. Pile driving hammers—single-acting Vulcan OR with rated energy of 30,225 foot-pounds.

General Cargo Wharf

The substructure of the general cargo wharf consists basically of steel pipe piles 24, 33 and 36-in. in diameter, and super H-piles made up of 36 WF and two 30 WF steel beams welded together. The piles act as friction piles and vary in length between 130 and 160-ft. Bents are spaced 25-ft. on centres, with piles spaced 20-ft. apart. Decking consists of reinforced concrete slab supported on wide-flange steel floor beams and pile caps.

The fender system is a continuous flexible type. It consists of vertical steel H-piles welded to horizontal steel H-wales, and faced with Greenheart timber wearing pieces. Rectangular rubber blocks, at three elevations, are used between the fender framing and the outer row of apron piles to provide the required flexibility.

The 40-ft. wide apron of the general cargo wharf carries twin railroad tracks and a travelling revolving portal crane of 30-ton capacity. Two catwalks with open-grating tread are provided below the apron deck along the full length of the wharf. Located at Els. +10.00 and +30.00, and immediately inside the outboard row of piles, these catwalks provide access to low-water mooring cleats. They are also used for inspection and maintenance.

TABLE 1.—Summary of Capital Requirements—First Phase

	FACILITY	ESTIMATED COST
1.	General cargo wharf and finger piers, transit shed, interior offices, railroad and highway connections	$4,500,000
2.	Railroad tracks and yards	725,000
3.	Roadways and surface drainage	125,000
4.	Water supply and fire protection	200,000
5.	*Grain elevator, grain wharf, conveyors, railroad tracks and roadways, complete	3,100,000
6.	*Molasses tank farm and terminal, complete	500,000
7.	Cargo handling equipment	500,000
8.	Land acquisition and term notes	492,500
9.	Escrowed interest, 2½ years	1,093,750
10.	Professional fees — engineering legal, fiscal agents	716,250
11.	Working capital and contingencies	547,500
	Total	$12,500,000

*Facilities to be leased: grain elevator (2,800,000 bu.) to Cargill, Inc.; molasses terminal (8,000,000 gal.) to Industrial Molasses Corp.

The transit shed, 625+ 200-ft., has a single row of columns spaced 25-ft. on centres down the middle. A clearance of 20-ft. is provided under the roof trusses. There are steel roll-up doors at both ends and along the two sides of the shed. The land-side doors give access to a loading platform 12-ft. wide, protected by an overhead canopy 18-ft. wide. This loading platform is served by depressed twin railroad tracks along the full length of the shed.

Shed and wharf are serviced with the usual utilities, including a fire sprinkler system and outdoor floodlighting. Interior offices and facilities for U.S. Customs Service, and for operating and stevedoring personnel, complete an efficient and properly integrated general cargo waterfront terminal.

For the consulting engineers, Frank L. Lincoln, M. ASCE, of Fay, Spofford & Thorndike, and Jack S. Burk, of Barnard and Burk, served as partners-in-charge. The writer served as Project Engineer for the overall planning of the project. For the Greater Baton Rouge Port Commission, Earnest D. Wilson is President, and A. Stewart Wallace, Jr., Manager.

Contracts for the construction of two quays at Truro and Mylor for the Truro City Council have been let to John Garrett & Sons Ltd., of Plymouth. Construction has recently commenced on both jobs, which are estimated to be completed about the end of the year at a tender cost of £122,000. The Consulting Engineers for these works are Posford, Pavry & Partners, London.

General Principles of Lighting at Ports

By H. FUGL-MEYER

The following two articles by H. Fugl-Meyer and Dr. W. A. Krause, discuss the general problems of port lighting and continue the series based on papers presented at the Third International Harbour Congress, which was held in Antwerp in June 1958, under the auspices of the Royal Flemish Institution of Engineers.

General Considerations

The need for adequate lighting at ports is particularly important in northern countries where during the winter months the days are short and the nights are long. The cost of keeping a ship lying in port is high—a matter of hundreds of pounds a day—and every effort should therefore be made to reduce turn-round times to a minimum. Hence the importance of having an efficient lighting system which will make night word as easy and safe as ordinary daylight work.

Lighting at ports was considered by the International Labour Office (ILO) at a meeting of experts on safety and health in port working, which was held at Geneva in December 1956 and at which, inter alia, the following recommendations were adopted:

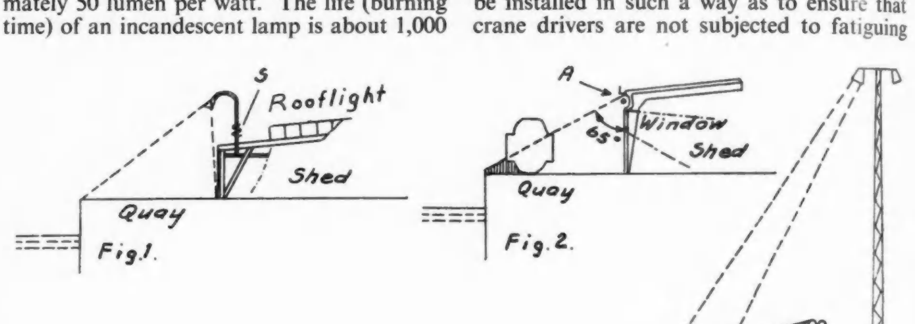
All places on shore and on board ships Ehere dockers have to work should be adequately lighted. The general level of illumination on wharves and quays where dockers must pass in the course of their duties should be not less than 5 lux (1 lux= 0.093 foot-candle). In places where loading or unloading operations are in progress—both on board ships and ashore—the illumination should be not less than 20 lux (illumination on a horizontal plane at a height of 90 cm. above the working surface). These standards apply primarily to general cargo working and are recommended as a guide in the planning of new lighting installations. They should be without prejudice to the provision of appropriate additional illumination in particularly dangerous places, e.g., at gangways, ladders, etc. In general, the lighting units should be so installed or screened as to avoid producing glare or dazzle. They should provide an illumination which is reasonably uniform and, as far as possible, free from deep shadows which could conceal a danger.

The ILO recommendations are concerned primarily with the safety of the dockers. The problem of lighting at ports presents other aspects as well.

Quays

Lighting fittings on quays should be installed preferably in protected positions so as to avoid being damaged by cargo-handling operations. Very often they are attached to the transit sheds or to the quay cranes. In the past a simple solution adopted at some ports consisted in the provision of lanterns, fitted with incandescent lamps, which were mounted on curved standards installed on the roof of a transit shed, close to the eaves (Fig. 1). Crane drivers could generally be relied upon to avoid hitting the vulnerable eaves gutters of the sheds. Should a lantern nevertheless sustain damage, it could be quickly replaced at small cost. A solution of this type is hardly adequate for present-day requirements, however. It generally fails to produce the effective and uniform distribution of light which is essential on a modern quay. Besides, incandescent lamps are expensive in regular operation.

For example, a typical tungsten filament incandescent lamp will have a light output of the order of 15—20 lumen per watt. The corresponding figure for sodium discharge lamps and fluorescent lamps is approximately 50 lumen per watt. The life (burning time) of an incandescent lamp is about 1,000



hours, whereas that of a sodium discharge lamp is about four times as long, whilst certain types of fluorescent lamps may have burning times of as much as 15,000 hours. The delicate filaments of incandescent lamps are moreover liable to be damaged by vibrations.

Sodium discharge lamps have the disadvantage of emitting monochromatic light which makes it impossible to distinguish between coloured markings on the goods handled or between shipping documents printed on paper of different colours, e.g., a pink copy for the owner, a yellow copy for the port authority and a blue copy for the customs.

On the other hand, modern fluorescent lamps give a sufficiently polychromatic light for distinguishing colours, besides being economical in operation and not easily damaged by vibrations set up by passing traffic or—in cases where the lighting units are fixed to a ceiling in a warehouse or transit shed—by the impact of heavy loads dumped on the floor above. Owing to its greater surface area in relation to its light output, the tubular fluorescent lamp is less likely to cause dazzle than are most other forms of lighting.

To conform to the ILO recommendations it is necessary to provide two sets of lighting units, one for general traffic purposes (producing an illumination intensity of approximately 5 lux on the quay surface), and an additional set capable of increasing the total intensity to 20 lux in places where work is in progress. Experience has shown, however, that an illumination of 20 lux is excessive for the purpose and may even be undesirable on account of glare effects. For general open-air work 15 lux may be regarded as quite adequate. Lighting units should preferably be screened so as to cut off any rays emitted at an angle of more than 65° with the vertical. In the case of quay lights they should be installed in such a way as to ensure that crane drivers are not subjected to fatiguing glare. Lighting units mounted as shown in Fig. 2 will produce fairly uniform illumination on a narrow quay apron. Railway wagons lined up on the quayside tracks will, however, intercept the light and cast deep shadows at the water's edge. In such cases it is necessary to provide auxiliary lighting in the form of portable cargo light mounted on the ship.

Fig. 3 shows a suggested lighting arrangement for a quay equipped with cranes and a two-storey transit shed. Lighting units—preferably tubular fluorescent lamps—are installed at A and B. This solution suffers from the same disadvantage as that represented in Fig. 2, namely, the formation of deep shadows behind railway wagons on the quayside. Extra cargo lights will have to be used in this case as well. A further improvement may be obtained by placing lights at each side of the crane portal at C. In addition, it is usual to mount a lamp on the jib of the crane, at D, to illuminate the load. This lamp should change its angle auto-

General Principles of Lighting at Ports—continued

matically as the jib luffs and should be so positioned as not to dazzle the drivers of adjacent cranes. In some cases a lamp is placed at E instead, its angle being adjusted by the crane driver.

Quayside lights should not shine out beyond the edge of the quay, with the attendant risk of dazzling and confusing the crews of vessels drawing alongside, but should be suitably screened. It is advisable to provide a 20 cm. wide white-painted strip along the edge of the quay and, in addition, to mount small reflecting plates (about 15 cm. by 40 cm. in size, treated with reflecting paint) on the waterside legs of the cranes. These precautions will enable the ships' crews properly to distinguish the quayside and facilitate the task of bringing the vessels alongside.

In some ports the lighting problem has been solved by installing floodlights on tall masts on the quay (Fig. 4). Such masts should be placed well out of reach of the cranes. They should produce the requisite 5 lux on the quay surface for general traffic purposes and they should be high enough to illuminate the edge of the quay even when a line of railway wagons is standing on the waterside track. To achieve this, however, it will generally be necessary to lay the tracks inconveniently far from the water's edge; besides, the sheds themselves are liable to cast awkward shadows. When cargo handling operations are in progress, lights mounted on the sheds (and, if necessary, on the crane portals) must provide the additional 10 lux needed to raise the total illumination to 15 lux. This solution could be a practicable one in the case of a quay having a wide apron. The masts could then be 40—50 m. high and be spaced 200—300 m. apart.

The efficiency of the general lighting system will obviously be affected by the reflecting properties of the quay surface and of the walls of the sheds. A concrete surface and light-coloured sheds may double the effect of the lighting as compared with a bituminous surface and dark-coloured sheds.

Ample and efficient lighting is even more important in the ship than it is on the quay. Slinging, palletising, stowing, etc., are basic procedures on which the operations of loading and discharging as a whole are dependent. Dark corners in the holds are sources of danger to the men and of damage to the goods.

Open-storage Areas, Marshalling Yards, Roads

The open-storage areas between transit sheds are generally lighted by lamps installed on masts or, preferably, on the sheds themselves. Precautions to protect crane drivers from glare are essential. The lighting units should be mounted as high as possible in order to minimise the shadows cast by the stacked goods. When no work is in progress on the storage area, the lighting should only illuminate the thoroughfares along the sheds with 5 lux, leaving the main area in semi-darkness.

For the lighting of marshalling yards it is generally not practicable to have a large number of scattered lighting standards or masts. The method nowadays most often adopted is to provide powerful long-range floodlights mounted on tall masts or towers up to 50 m. in height. One such mast may be provided for every four tracks. The beams of the floodlights are trained parallel to the tracks. The next transverse row of masts may be placed some 400 m. from the first. An average horizontal illumination of 2.5 lux should be provided, with additional lighting at key positions. The masts are usually equipped with 1,000-watt lamps. In marshalling yards it is quite suitable, and even preferable, to use monochromatic light (which is less fatiguing to the eyes than polychromatic light).

Generally speaking, the same rules apply to the lighting of roads in port areas as to the lighting of ordinary roads. The lighting units should be mounted at a height of 9 $\pm$ 1 m. above road level and they should be spaced about 45 m. apart. Roads with light-coloured surfaces should have an illumination intensity of not less than 4 lux; with dark-coloured surfaces this should be at least 6 lux. The minimum illumination values for cross-roads are 6 and 8 lux in the two above cases respectively. Fluorescent lamps provide the most suitable form of road lighting. The lighting units may be mounted on standards or, alternatively, they may be suspended from span wires (though this is not an acceptable solution on thoroughfares where large mobile cranes are likely to pass with their jibs raised).

Transit Sheds and Warehouses

For the natural lighting of transit sheds and warehouses vertical glazing is preferable to rooflights. The latter tend more quickly to become opaque with grime and soot, and in winter they are liable to be obscured by snow. Vertical glazing moreover provides better lighting for distinguishing the markings on the goods handled.

Artificial lighting in warehouses and sheds should be suitably polychromatic. The lighting units should preferably be mounted at a high level so as to be well out of the way of mechanical handling appliances and to produce uniform illumination. The horizontal spacing of the units should be about 1½ times the vertical distance from the source of light to the working surface. An illumination of 40 lux should be provided at a level of 90 cm. above the floor. As in the case of external lighting, fluorescent lamps are most suitable. The ceilings, walls and columns of transit sheds and warehouses should be whitewashed in order to enhance their light-reflecting capacity.

Offices, canteens, wash-rooms, etc., should of course also be adequately lighted. The following illumination values are recommended: 200—300 lux for general offices, 200 lux for meeting-rooms, 300—500 lux for drawing offices and typing rooms 100 lux per canteens and wash-rooms, 50 lux for corridors and staircases.

Lighting Arrangements at some Continental Ports

By Dr. W. A. KRAUSE

Roads and Access Ways

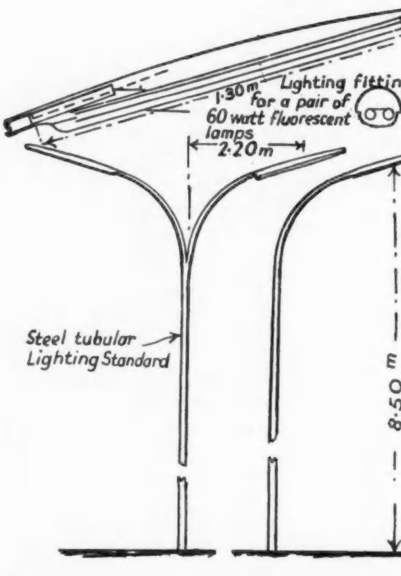
At Hamburg, fluorescent lamps are used for general street lighting in the port area. These are mounted on tubular steel standards of simple and pleasing design, which are either of the single or the double type (Fig. 1), the latter being used on dual-carriageway roads. The lanterns are connected to special supply cables permitting centralised control by means of automatic time switches. The mounting height is 8.5—9.5 m., the standards being spaced 30 m. apart on main thoroughfares (where an illumination of 5 lux is provided at the centre of the roadway) and 60 m. apart on roads of secondary importance. Where a road runs close to a waterway, the standards are placed facing away from the water so as to avoid causing glare or dazzle to vessels.

The general intensity of illumination provided on traffic routes at Dunkirk is approximately 4 lux, the lanterns being mounted on 10 m. high lighting standards spaced 30–40m. apart. According to the width of the carriageway (e.g., 7, 10.50 or 14 m.), the standards are installed either on one side of the road or on both sides; in the latter case they may have a staggered arrangement or be placed opposite each other in pairs. On dual-carriageway roads the lighting standards are of the double type and are placed on the central reservation. At intersections twice the intensity of illumination is provided, viz., 8 lux. Car parks are illuminated with about 20 lux. The lighting system is controlled by a time switch.

The main road between the town of Dunkirk and the marine terminal is lighted by 140-watt sodium vapour discharge lamps with a light output of 67 lumens per watt. The other roads in the port area have mercury vapour discharge lighting, the 125-watt lamps being of the type fitted with a fluorescent outer bulb and having an output of 35 lumens per watt. The initial cost of this latter form of lighting is lower than that of sodium or fluorescent lighting, and its use is increasing.

In the port area of Antwerp street lighting is effected by means of 40-watt fluorescent lamps mounted in watertight fittings on 6.5—8 m. high standards spaced at intervals of 12—15 m. Complete modernisation of the external lighting in the port area is envisaged. In future, 85-watt and 140-watt sodium vapour discharge lamps and 80-watt and

Lighting Arrangements at some Continental Ports—continued



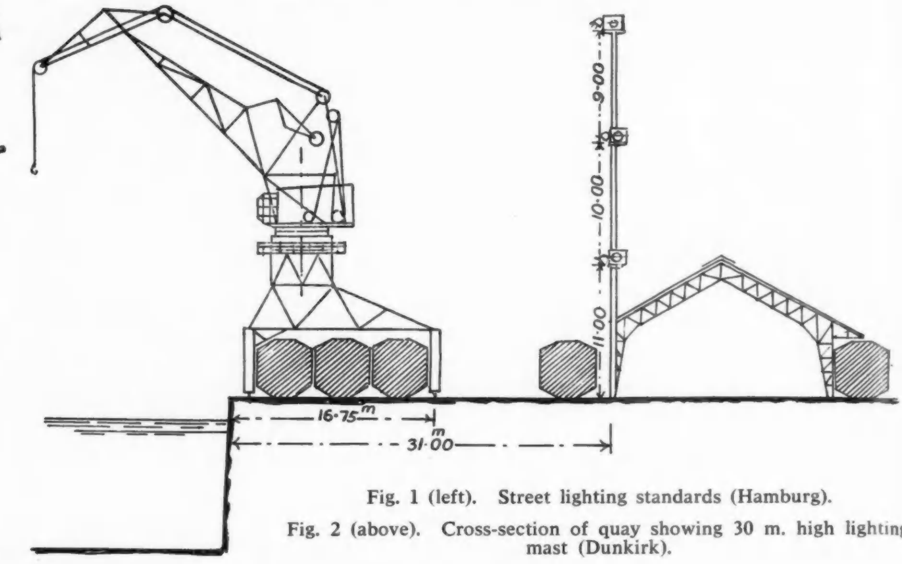


Fig. 1 (left). Street lighting standards (Hamburg).

Fig. 2 (above). Cross-section of quay showing 30 m. high lighting mast (Dunkirk).

125-watt mercury vapour discharge lamps will be employed; these will be mounted in open fittings on 8—9.50 m. high steel or prestressed concrete lighting standards spaced 30—40 m. apart. Sodium lighting is to be used only in places where it is not essential to distinguish colours. The areas between transit sheds will be lighted by 40-watt flourescent lamps.

Landing Piers and Quays

The St. Pauli floating landing stages at Hamburg, which were built in 1954, afford a good example of the lighting of a modern passenger pier. The pier buildings have projecting awnings carrying tubular fluorescent lighting units at their edges. These provide an illumination of 120 lux directly below them, diminishing to 10 lux at the edge of the landing stage. The Steubenhöft marine landing pier at Cuxhaven has three continous lines of fluorescent lighting mounted at different levels on the pier building and providing an illumination of 60 lux at the centre of the pier.

Cargo quays may be lighted by means of lighting units mounted on tall masts or, alternatively, attached to the transit sheds. The Port of Dunkirk affords an example of the former solution. An illumination intensity of 12—15 lux is required in places where cargo handling operations are in progress, with the additional requirements that the illumination should be uniform, that the lighting masts be well clear of the cranes, that no deep shadows be formed, and that glare and dazzle effects be avoided. On a quay 500 m. in length and 30—40 m. in width the lighting problem has been solved by the provision of two 30 m. high prestressed concrete masts installed at a distance of about 30 m. from the edge of the quay and at ¼ and ¾ of the quay length (Fig. 2). Each mast carries three 400-watt mercury-fluorescent lighting units mounted at heights of 11, 21 and 30 m. respectively.

The latest transit sheds and Hamburg and Bremerhaven carry external lighting units which are screened so as not to shine out beyond the edge of the quay. At Hamburg these units are installed at a height of about 7 m. under the eaves of the transit sheds. On the waterside of the sheds they are spaced 9 m. apart and on the rear side they are spaced 18 m. apart. Each lighting unit comprises two 40-watt fluorescent lamps. The intensity of the illumination decreases from 20 lux at the doors of the shed to 6 lux at the edge of the loading platform along the front of the building. Supplementary lighting is provided by lamps mounted on the crane portals.

At Hamburg, marshalling yards and sidings are lighted by means of 65-watt tubular fluorescent lamps mounted in pairs on 10—12 m. high lattice masts installed in rows between tracks.

Cranes

Modern cranes and similar cargo handling appliances should be equipped with adequate lighting devices to ensure their efficient operation at night. The lights fitted to the portals and jibs of cranes should ensure adequate illumination in the vicinity of the crane (approximately 10—15 lux), they should illuminate the load during the whole of the time it is suspended in mid-air, they should sufficiently illuminate the surroundings of the crane to enable the driver to avoid collision with adjacent cranes or with the superstructure of the vessel, and they should cause the least possible glare and dazzle. The latest portal with two adjustable 100-watt lamps which illuminate the working area around the crane. The jib carries two 100-watt lamps which are kept directed vertically downwards during all slewing and luffing movements.

Cathodic Protection of Steel Sheet Piling on the River Tyne

By W. R. SHEPHERD, M.Sc., Tech., M.I.E.E.

The Tyne Commission Quay at North Shields was constructed in 1927 for the Norwegian Mail Boat Service to Bergen. The river side of the quay is protected with a 900-ft. line of steel sheet piling consisting of 15-in. x 5-in. rolled steel joists driven flange to flange and interlocked to form a continuous bulkhead. It is situated under the quay at distances varying from 9-ft. to 25-ft. from the berthing line, its purpose being to afford protection against the effects of dredging and river wash.

The top of the piling is about 7-ft. above L.W.O.S.T. and every alternate pile is driven down to mud level which is 11-ft. below L.W.O.S.T., the piles being 53-ft. and 35-ft. long, respectively. Both sides of the piling are exposed to the tidal river water which is highly polluted, the total area exposed being 44,000 sq. ft.

In 1948 it was found that the piling had been corroding at a rate of .0065-in. per annum and that disturbing consequences would arise in the next 20 years if some action were not taken to arrest the corrosion. The presence of a heavy reinforced concrete deck above the piling precluded the possibility of pile renewals.

The formation of anodic and cathodic areas on steel structures is a well-known phenomenon, but in the year 1948 there was very little knowledge available about the cathodic protection of large scale field works in this country, though more was known of pipe line protection in the oil industry abroad, ships' tanks and hulls, and power station condenser plants.

There was no option, therefore, but to

Cathodic Protection of Steel Sheet Piling—*continued*

pioneer a scheme of protection, and the following account of the detailed developments has its interest.

The first question to be resolved was the use of sacrificial anodes versus the impressed voltage system.

Sacrificial anodes of magnesium have many good points, but at that time it seemed that lack of control of the rate of sacrifice was a disadvantage, as also was the price. In times of national emergency there was also the certain risk that supplies would be more than difficult, nor could the reasonable stability of market prices be counted upon.

Approach was made to the Cumberland Engineering Co. Ltd. of Liverpool, who were experienced with protection of power station auxiliaries and ships' tanks etc., and a pilot plant was installed in 1950 comprising a small bulb type rectifier and a single anode. The latter consisted of a stainless steel rod 2-in. dia., 14-ft. long, mounted on a hinged arm supported on the piling. Oak blocks insulated the anode, and stainless steel tapes and similar nuts and bolts formed the electrical circuit to the anode. The anode was 3-ft. in front of the piling and parallel with the vertical face. The electrical loading gave a current density of 12 milliamps per sq. ft.

Within 12 days the anode had sacrificed itself together with its connections and bolts, but there was visual evidence of softening of the scale and other deposits on the piling in the immediate vicinity of the anode.

M.S. shafts from scrap were then used for a small number of anodes but although the clamped cable connections proved very troublesome as metal reduction occurred, a much longer life was obtained. During the next phase a potential survey was carried out and a large scale scheme designed.

This comprised a 4KVA rectifier plant fed from the 415-volts 3-phase supply, the D.C. output of 300 amps at 10 volts feeding 50 anodes in 10 groups of 5, each group having an ammeter and resistance control in the main panel. Adjustable tappings on the rectifier transformer provided coarser regulation. The main supply to the rectifier was metered for costing purposes.

In October 1951 C.I. hemispherical anodes were suspended via small pulley tackle from the underside of the quay at points in front and at the back of the piling, using a M.S. shackle pin and lug on the anode and nylon suspension ropes.

The electrical connection to the anode consisted of a small V.I.R. cable let into a deep hole in the anode filled in with molten lead.

These anodes weighed 1 cwt. and cost £4 10s. each and were not of any special character regarding the carbon content.

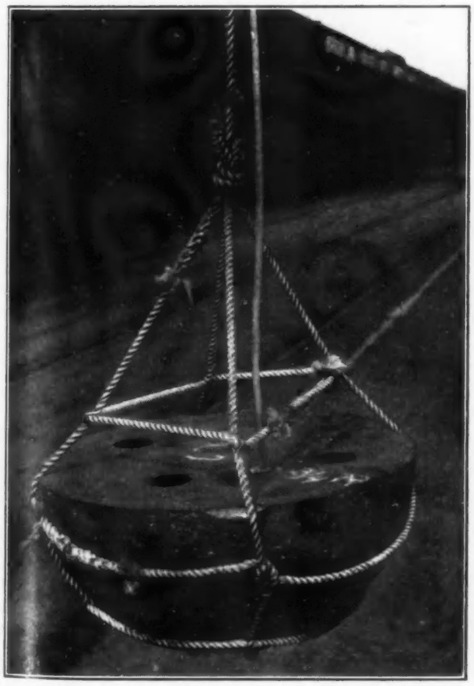
Within 2 months trouble occurred with the corroding away of the M.S. shackle pins and eyebolts on the anodes, and to overcome this, nylon rope nets were made in which to cradle the anodes. No further trouble occurred and it was an easy matter to haul up any anode for frequent inspection.

The current passing to each anode at this time was 7 amps and the average loss of anode weight was 8 lbs. in 42 days, from which it was assumed that their life would be about 18 months. In actual practice the average life proved to be 16 months.

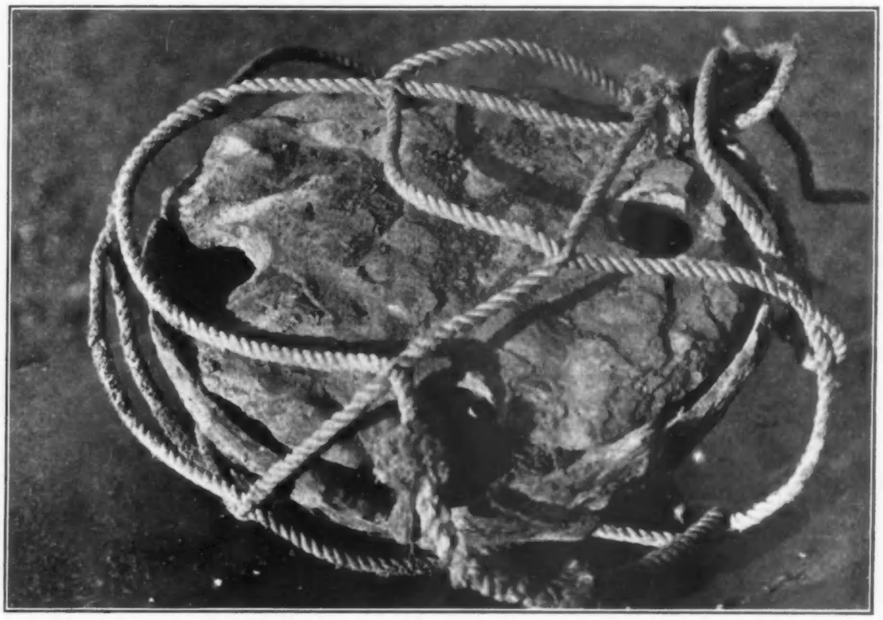
Apart from slight loosening of scale and marine deposits, which could be released by gently scraping the piling surface, there was nothing very determinate as to the degree of protection afforded. M.S. test strips 12-ft. long x 1-in. x $\frac{1}{8}$-in., polished on one face, were therefore clamped to the piles on cleaned surfaces to act as witness strips.

These were long enough to show the effects of protection in the mud zone, below low water, and the splash zone which was

Comparison between new T.I.C. cast-iron anode and one in use for 7 months.

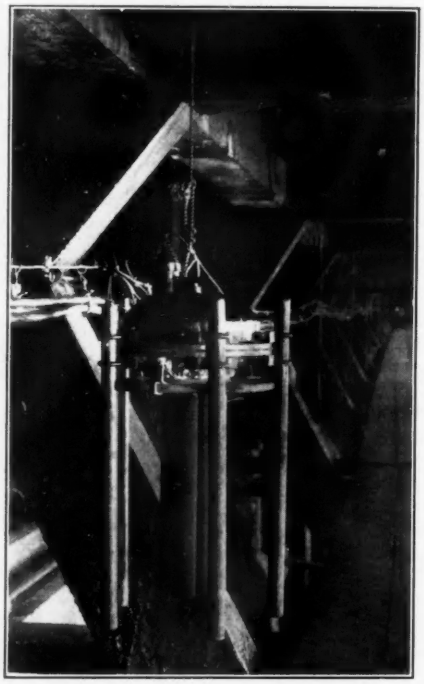


T.I.C. hemispherical cast-iron anode showing method of suspension using nylon rope and electrical wiring and connections.



The T.I.C. cast-iron anode which replaced the original Cumberland anode. This anode took an excessive amount of current.

Cathodic Protection of Steel Sheet Piling—continued



Modified Cumberland anode showing method of suspension by nylon rope.

uncovered twice daily by the tide. They served a very useful purpose and over a period of 12 months indicated, visually, that protection was being achieved. Later it was realised that the test strips should be welded to the piling system to secure undeniable homogeneity.

The final design of witness or test plates comprised steel plates 2-in. wide x 24-in. long, with one face ground and polished. A heavy flexible steel cable was welded to the late and the piling system, and each plate could be conveniently brought out for visual inspection.

A marked area of each polished face was micro-photographed at yearly intervals. Three plates were used in the zones mentioned above.

The improved type of witness plates gave a very true indication of the degree of protection being afforded. The earlier type, due to poor contact with the piling system actually showed the formation of anodic areas in one or two cases.

A point of interest can be mentioned concerning the electrical continuity of the 900-ft. long piling system. This was found to be so good that only one heavy return conductor welded to the centre of the system was needed.

It is essential to determine this sideways conductivity and where lacking the gaps should be bridged by welded connections. Possibly the return conductor from the piles could be paralleled by two similar conductors all equally spaced to effect a better distribution, and this matter is receiving consideration for the Tyne project.

Frequent periodical readings of anode group currents were logged, concurrent with C.I. anode weighings. In this way the life of each anode was obtained and the rate of sacrifice noted.

It was seen that all anodes in the same group of five did not have equal lives, also that there was a wide variation between groups. Individually, a minimum anode life of 7 months and a maximum of 24 months were recorded, the average being 16 months.

In 1954, several changes were made. The first was the purchase of a high resistance voltmeter and copper half-cell reference electrode which enabled a potential survey to be made of the piling.

After a complete survey it was apparent that each anode required an individual variable resistance unit, so that by adjustment of individual anode currents the potential curve could be smoothed out in relation to the datum line of 0.85 volts, because some areas were over protected and others not sufficiently protected.

It was necessary also for the 50 resistance units to be located within reach from the timber platform above the piling system for rapid adjustment during tests. This called for some care in the selection of the cases housing the resistance units, and watertight galvanised steel boxes with brass fittings and fixings were eventually fitted.

About this time it was decided to adopt anodes using graphite as the sacrificial medium with a view to obtaining a longer life, thus reducing the labour costs associated with renewals. The Cumberland Engineering Co. Ltd. were invited to develop an anode of this type, and after a series of trials a batch of 25 solid carbon rods 5-in. dia. x 20-in. active length, having a ceramic cap embodying the cable connection and suspension detail, was introduced to form a series of five adjacent groups.

These anodes at that time cost £13 10s. each while C.I. anodes were £5 15s. each.

One group of five anodes near the end of the piling system, and therefore running at a slightly higher current density, lasted 34 months, but the remaining four groups lasted over four years.

By this time the other 25 T.I. anodes were run to the end of their useful lives and replaced by the Cumberland carbon anodes.

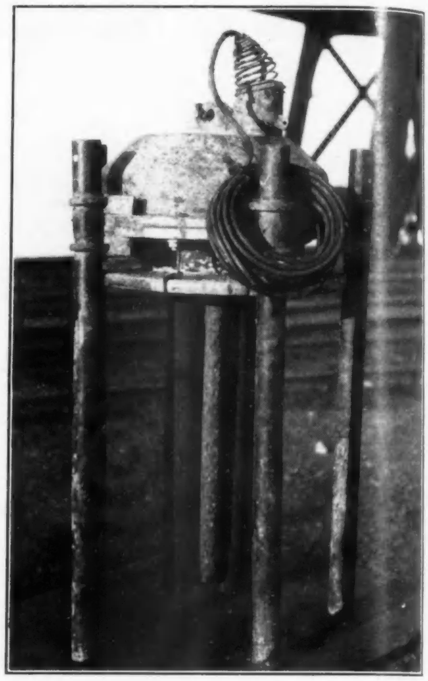
In the early part of 1958 two trial anodes of a later design known as Cumberland " Coralite " anodes were installed in one of the groups.

The following advantages are claimed for them:—

(1) They are less than half the price of the others.
(2) They have no ceramic heads and are smaller than the other type.
(3) They have no back E.M.F. relative to steel, and require less power than the others.
(4) They are easier to store, needing less space.

It will be some time before any report can be made concerning the new type of ferrous alloy anodes. If a comparable life can be obtained then they will certainly be adopted.

Alongside the trials with " Coralite " anodes, life tests are also being made with



This unmodified Cumberland anode had nearly 7 months' service. Test indicated that it was failing. Note the deterioration of one of the 4 carbon rods. The reason for preferential attack is not clear at present.

another type known as " Carbinent ". These have a 6-in. dia. stem 20-in. long of wax impregnated graphite and cost approximately £8 10s. each, when installed. Like the " Coralite " anodes it will be some time before final judgment can be passed.

Some information about costs may be of interest but it must be appreciated that these are related to the particular tailor-made scheme, and include capital expenditure on the provision of an extensive timber access platform under the quay and along its full length.

The running costs are also influenced by the absence of any form of external protective paints or coatings on the piling, which benefits can generally be obtained with new installations as a matter of course.

Capital Costs		Maintenance and Renewal Costs	Electricity Costs at 1½d. per Unit	Total
1950, 1951, 1952	£4,000	—	—	£4,000
1953		£431	£186	£617
1954		£981 (10 control boxes £335)	£117	£1,098
1955		£484 (20 anodes £270)	£154	£638
1956		£240	£208	£448
1957		£329 (25 " Carbinent " anodes £175)	£145	£474

The Role of the Port Authority in Shipping Turn-round

By F. D. ARNEY, C.B.E., M.Inst.T.
(General Manager, Port of Bristol Authority)

The various factors that port authorities must take into account when attempting to speed up the turnround of shipping were discussed in a paper read before the Institute of Transport in London on the 12th of this month by Mr. F. D. Arney.

Mr. Arney prefaced his remarks by recalling that the Government set up a Working Party which reported in 1948 on this subject, and arising from which a Ports Efficiency Committee was set up and is still in being to study and enquire into any unusual delays which may take place. It was not so long ago, he continued, that every time a shipowner spoke in public you could be quite certain that some reference would be made to the loss of time ships wasted in port compared with pre-war days. The principal contributory factors to that disturbing picture were the substantial loss of berthing space in our ports due to war damage amounting to some £30 million, and the numerous industrial disputes, both in Britain and overseas, which seriously retarded shipping turnround. A further factor, not always accorded its fair recognition, was that ships were loading export cargo from this country to a much larger extent than pre-war, necessitating a longer stay in the port. The problem was further aggravated often by the shortage of tonnage due to war losses and sellers' market conditions followed by the Korean war and the Suez venture. The position today had changed for the better in many respects; war damaged ports had largely been made good and, in addition, since 1945 the major ports of the country had spent a further £35 million in port improvements.

"Although we are now in a position to give better service, a slump in the shipping business, particularly in tramp cargoes, is being experienced, and this offers us a further challenge since it is more important than ever that during a slump period the earning capacity of ships remaining in service and measured by days at sea should be the maximum possible," Mr. Arney said. "Statistics recently published show that on average British shipping still spends 50 per cent of its time in port, but averages of this kind can be very misleading. In the short sea trades a vessel might well spend two-thirds of its time in port whereas, say, in the Far Eastern trade, the proportion might be only one third.

"It is extremely difficult to obtain true comparisons on a national basis, but from my own experience I think it is fair to say that in ports in this country, and making due allowance for changed circumstances, ships are now being discharged and loaded as quickly as in pre-war days. The shipowner, however, says with some force that this is not good enough—ship design, speed and equipment have all improved in recent years and the owner expects port operations to keep in step."

It was, of course, true to say that in broad outline every activity of a Port Authority was, in one way or another, concerned with turnround, but the impact could, and did, vary considerably from port to port according to the degree of participation by a particular Port Authority in the actual process of handling cargo. Some Port Authorities did little more than provide and maintain a dock system and leave everything else to private operators, and at the other end of the scale there was the Authority that provided every service relating to port operations. Most Authorities came somewhere between these two extremes.

On the question of navigational aids in ports, Mr. Arney pointed out that it was now quite usual for shore signal stations, which had previously relied on visual signals, to be equipped also with V.H.F. radio telephony, and for ships regularly using the port to be similarly equipped thereby enabling speech communication to be maintained between ship and shore. Unfortunately this was something of a piece-meal development without uniformity between countries as regards allocated wave bands and frequencies, so that V.H.F. equipment suitable for one place was virtually useless elsewhere. Steps had now been taken through the G.P.O. to remedy this, and in course of time radio telephony between ships and port shore stations should be both nationally and internationally standardised.

Layout of Quays and Sheds

After dealing with pilotage Mr. Arney turned to the layout of quays and sheds. He said that the early development of ports in Britain took place on the main rivers and usually some distance inland with wharves along the river banks. Consequently most ports were subjected to fairly wide tidal fluctuations, and with the growth of trade and the size of ships so the need developed for impounded docks where ships could remain afloat and continue to discharge or load unhampered by the range of tide. The shape of the actual water area excavated or impounded largely depended on the physical feature of the location and the link up with inland transportation. In places only subject to a small range of tide, and where the depths were sufficient for ships to remain afloat, riverside wharves and finger piers were still the accepted method of port construction. It was, of course, the design of port shore facilities that over the years had offered the greatest scope for improvement. It was a relatively straightforward matter to plan the facilities for a homogeneous cargo, particularly when handled in bulk. Most of the operations connected with such cargoes were highly mechanised and it became largely a problem of matching the capacity of discharging and loading equipment such as cranes, grabs, pneumatic plant and the like with the speed of the shore reception and delivery facilities.

It is when general cargo working was considered that a decision regarding layout became much more difficult to make; the question of how many lines of railway track should be provided on the quay; whether road vehicles were to be dealt with alongside the ship; the most suitable type of transit shed; what mechanical appliances were to be used, all called for careful planning. The great variety of general cargo made it almost impossible to adopt anything in the nature of a standard layout, and since the best provision for one type of cargo was probably unsuitable for another, more often than not a compromise had to be made. In the case of inward cargoes the Bill of Lading usually required the consignee to receive as fast as the ship could deliver, and if congestion on the quay was to be avoided, the number of outlets to move cargo away must be sufficient to cope with the rate of discharge. The shipowner naturally wanted the highest possible output, and the consignee the cheapest method of handling. These two requirements could, at times, conflict. The normal division of responsibility was that the shipowner paid out of the freight the cost of discharging cargo from the hold to quay alongside, and either performed the work or employed a master stevedore to do it. The consignee was responsible for the cost of receiving the cargo on the quay and moving it away, for which purpose he employed a master porter which, in many cases, was the Port Authority. With export cargo the movement was reversed, but the division of responsibility for cost was much the same.

The foregoing procedure was not universal, custom of the particular port could mean a variation and at times, even in the same port, different shipping conferences did not conform to a standard practice. Many types of cargo did not require detailed sorting or Customs examination and provided the ship delivered to Bill of Lading leading mark it should be possible to arrange direct delivery to rail, road or overside to barge or coaster which cheapened handling costs, but if delay to the ship was to be avoided, it was important to see that the shore arrangements could stand up to demands.

A wide quay apron was a necessity for direct working to rail and road with standage for road vehicles, clear of railway lines if possible. It followed that the flow of trucks and lorries to the loading points must be maintained without unnecessary delays. Rail working required a standage grid of sidings within easy reach of the berth, and a liberal provision of capstans or a shunting tractor at the quayside. The substantial growth in the quantity of cargo now moved by road had provided most Port Authorities with new problems:— making access roads to quays and sheds; the metalling over of railway tracks; provision of loading bays; standage for waiting vehicles; all of these have had to be overcome, together with the need to regulate the flow of vehicles to correspond with the requirements of discharging and loading.

Cargo which required sorting and examination before despatch had to be put down in a shed and the variety of shed designs illustrated what he had said earlier regarding the difficulties of deciding on the most suitable type and layout. For ease and

The Role of the Port Authority—continued

economy in working, the large single-floor shed had many advantages, but few Port Authorities could afford the land space to adopt this policy, so that the trend, in Britain at least, was for double-floor sheds. It was important that there should be as many outlets from a shed as possible both to avoid unnecessary and expensive internal movement of cargo and to speed up clearance. The kind of mechanical equipment to be used in the shed must be considered in relation to design, and one must always keep in mind that over the course of years the type of general cargo and packaging could undergo change. Mr. Arney personally favoured the steel framework and light panel type of shed construction as it lent itself more readily to modification to meet changing conditions. The initial cost of this style of shed was lower than reinforced concrete or brick construction, but maintenance costs were higher. General cargo did not, as a rule, call for special ventilation, but it was desirable to avoid wide temperature variations, and in winter time the heating of sheds receiving fruit cargoes might be necessary. Much time and effort had been wasted through lack of adequate internal lighting, but it was now generally recognised that a good standard of lighting and the painting of the shed walls in a light-reflecting finish more than repaid the cost. Delivery facilities from the first floor of double-floor sheds should, as far as practicable, be kept clear of ground floor working, and was generally achieved by the use of external lifts, hoists and cargo chutes, delivering goods directly to loading platforms at the rear and ends of the shed.

The increasing use of heavy mobile appliances on the quays entailed more substantial surfacing which, although not difficult to provide on quays of solid construction, created costly problems on quays where the surface was carried on a piled formation. Concrete quay surfaces, although hard wearing, suffered from the defect of being difficult to repair, and cracking due to settlement, extremes of weather and other causes could mean a major repair job. Alterations and repairs to service mains also caused disruption and delay. These defects could now be largely overcome by the use of prefabricated concrete slabs encased in a steel frame.

Mechanical Appliances

On the question of port mechanisation, Mr. Arney said, "I find that there is a fairly widespread impression that the dock industry is reluctant to introduce mechanisation, and although I admit that progress has been slow, and not without teething troubles, yet compared with the situation, say, ten years ago, much has been achieved, and by virtue of the part they play in the handling of cargo it has been the Port Authorities that have provided most of the new equipment.

"The mechanical handling of bulk cargoes has probably shown the greatest advance in recent years; heavy duty grabbing cranes linked with hoppers and conveyor belts are giving outputs of 250 tons per ship per hour on ore cargoes. The grabbing of bulk sugar cargoes; the improved capacity of pneumatic plants for handling grain, phosphates, etc.; the increasing use of wagon tippers for loading, and the higher rate of pumping of bulk liquids all help to reduce a ship's non-productive time. By comparison the use of mechanical appliances on general cargo is less spectacular, but nevertheless a visitor to our quays today would find such items as fork lift trucks adapted to handle a variety of cargo, electric and petrol driven runabout trucks, mobile cranes, portable stackers, shunting tractors, mobile conveyor belts, prime movers and trailers. During the past ten years about 800 new quay cranes of improved design and faster working speeds have been installed in our home ports. There is a temptation once a piece of equipment has been provided to use it on every possible occasion without regard to whether it really speeds up the work or cheapens the cost. Every job should be carefully analysed and costed, and it is of particular importance that foremen and others in charge of operations should receive instruction on what each piece of equipment is capable of doing, how it can be best used, and when not to employ it. Needless to add, the actual operators of these relatively expensive machines should undergo thorough training and my experience is that the operator takes more care of, and pride in, his equipment, if he is the sole user."

Labour Relations

On the subject of labour relations, Mr. Arney said, "It is still true that, notwithstanding the new and improved appliances available today, the manual effort of dock labour is by far the most important factor in turnround, yet in my opinion little has been done, taking the industry as a whole, to subject dockside operations to work study investigations. I believe that if the object of such investigations was properly explained to dock workers their co-operation could be obtained, and the result would benefit them as well as their employers.

"I expect many of you are aware that dock work for the most part is paid for on a piecework, or perhaps more correctly, a bonus, system. The national rate for timework is fixed by the National Joint Council for the dock industry, and is at present 15s. 5d. per half-day. It is a 'fall back' rate and is paid irrespective of output. The bonus rate is usually based on either a gang rate per ton, or a per man rate per ton, and is paid on all tonnage in excess of that represented by the timework rate. There is, however, an important proviso, viz. where work is carried into the afternoon or second turn, bonus is calculated by reference to the tonnage for the whole period so that, from the men's standpoint, good output in the first turn can be nullified by delays in the second turn. Conversely if the delays take place in the first turn the incentive to earn bonus in the second turn can be destroyed. In my view this daily assessment of bonus can be detrimental to good output, and I should like to see a system whereby the total bonus value of the cargo to be discharged or loaded in each hold is paid as a unit on completion of the work. There would, of course, have to be adjustments to meet special circumstances, but this is quite common today, and presents no new problem. I think such a system would tend to even out the effect of unavoidable delays. A hold-up of an hour's duration set against eight hours' work can be a considerable disincentive, but set against several days' work it loses its significance. I believe that the men would cease to regard the job on a day-to-day basis and would be more inclined to step up the tempo of work with the object of achieving their bonus payment in the least possible time, so making themselves available for the next job.

"Bonus rates are fixed locally, and were introduced in most of our ports under stress of war circumstances. Many of them were fixed without any real attempt at job rating, consequently some rates yield high earnings without corresponding effort, and others are too low and retard incentive. It may be asked why something is not done about this, but I can give the assurance that it is not for the want of trying. It is an easy matter to increase low bonus rates, but employers consider there should be give as well as take, and in the majority of instances there has been little evidence of this frame of mind on the part of the workers.

"It is not within the scope of the paper to go into the complex structure of the dock industry and to trace the effect that this has on labour relations. In times of dock strikes, it is the Port Authority that is hardest hit and for this, if for no other reason, it should play an active part, and perhaps the predominant part, in trying to maintain good labour relations in its port. Senior officials should be encouraged to participate in the affairs of local joint committees, and more important still, foremen and other supervisory staff should receive training in labour management. Many disputes have small beginnings, and the ability to localise trouble by prompt action can prevent more widespread disruption. In my view the greatest obstacle to better employer/worker relations is that the majority of dock workers are still employed on a daily basis making it extremely difficult to foster the loyalties on both sides that are common in other industries. The Dock Labour Scheme provides for the weekly engagement of workers, but so far there has been a marked reluctance on the part of the bulk of the men in the industry to attach themselves to a single employer."

Conclusions

In conclusion, Mr. Arney said that Port Authorities had done much in recent years to improve facilities, though there were no

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Earth Moving by Suction Dredger

Removal of Overburden by Pipeline

A departure from the conventional method of earth moving has been made at Westfield Opencast Site, where Richard Costain Ltd. are removing overburden by suction dredger. The site is at Kinglassie, Fifeshire, and the excavation area of about 135 acres contains a peat layer covering sand which runs to a maximum depth of 40-ft. Dredged material is deposited in an area which has been previously enclosed by embankments. The contract is being carried out in conjunction with Blankevoort and Zoon of Bloemendaal, Holland, and this is claimed to be the first time such a method has been used in the United Kingdom.

The nearest navigable waters to Kinglassie are some 20 miles away, consequently the component parts of the dredger had to be transported to the site by road from Leith, a distance of about 70 miles. Originally constructed in Holland, but working more recently in Belgium, the dredger "Vlaanderen XI" which weighs 550 tons is believed to be the largest of the sectional cutter type dredgers in Europe. Four ships brought the dismantled dredger to Leith, and two more ships carried the pontoons and some 500

The dredger being erected.

pipes totalling 9,000-ft. in length which were to form the floating and shore pipeline. One of the largest sections weighed 27 tons and was 71-ft. long.

The length of the dredger is 143-ft. with a beam of 23-ft. and draught of 6-ft. Oil storage pontoons fixed to the sides bring the total width to 39-ft. The cutter ladder mounted on the bow is 71-ft. long, and at the end of it is a 7½-ft. diameter cutter, which covers the mouth of the suction pipe.

"Vlaanderen XI" operating at the open cast site.

To facilitate the assembly of the dredger a dry dock had to be dug out, and the excavation area was flooded from a stream running through the site. This flow was augmented by water which had been pumped out of Kinglassie colliery 1¼ miles away and carried to the site by a 9-in. pipeline put in by the contractors.

The dredger was erected by a 48-ton gantry with four electric hoist motors, which offloaded the lorries from an access road at one end of the dry dock and transported the pieces to their appropriate positions. When the assembly of the dredger was completed, in August 1957, the craft dredged its way out of the dock.

The dredger has no propulsive machinery but is held in position by dropping down to the bottom of the excavation one of two vertical spuds at the stern. Two head ropes running through sheaves at the end of the cutter ladder are attached to port and starboard anchors placed some distance from the dredger on land. By winching these two head ropes the dredger can be slewed about the fixing spuds and can be moved forward by dropping alternate spuds.

Power for the cutter and winch motors which raise and lower the cutter ladder and spuds and operate the anchor ropes, is provided by two diesel-electric generators on board which supply a total 450 K.W.

The suction pipe is situated within the cutter so that material broken by the cutter is immediately drawn into the suction pipe, which carries it to two 7½-ft. diameter pumps each driven by 1,520 h.p. motors. The pumps delivered an average of 20,700 gallons per minute of a mixture of water and solids at a total head of 70-ft. over a mile of 26-in. delivery pipe.

The pumped material is discharged at the stern of the dredger through a swivel end to which is connected the delivery pipeline. Over the water the pipeline is carried on pontoons with a length of flexible pipe between each pontoon.

In operation the dredger has first to cut a face down to the sand layer. This is done by starting at the top of the material to be excavated, the dredger then moves slowly in an arc, backwards and forwards as the port and starboard ropes are pulled. The cutter is lowered as the material is excavated. Often the material is undercut, and falls down on the cutter, where it is broken, and drawn into the suction pipe.

The material is conveyed by pipeline to storage embankments which are divided into two compartments with a total storage capacity of about 3.8 million cu. yds. The mixture settles in the area and the water is drawn off by flumes constructed on the inside of both compartments. Smaller embankments 17-ft. high which were later built on top of the existing ones increased the storage capacity to 5.3 million cu. yds.

The dredger is capable of handling an average of 900 cu. yds. of solids per hour. During continuous working, except for weekends, the output of the dredger was 4,382,000 cu. yds., in 49 working weeks, an average output of 90,000 cu. yds. per week.

(Continued from previous page)

grounds for complacency. The pattern of cargo handling was changing all the time. In the future we could expect more developments in the carrying of cargo in bulk, in containers and in unit loads, as well as a further expansion of "roll-on and roll-off" traffic. In order to meet the challenge effectively, the port industry should be much more ruthless in their attitude towards scrapping the old and obsolete, and in undertaking experiments on the handling of cargo by new methods. However, he pointed out that Port Authorities in Great Britain were non-profit-making bodies, and had to try and make revenue and expenditure balance taking one year with another.

Dock dues on vessels and goods were statutory charges subject to control either by Act of Parliament or by Ministerial Order, and in general had not increased in anything like the same proportion as the rise in cost of wages and materials. As a maritime nation we had developed too many ports for the size of the country, consequently competition was so strong that few, if any, of the ports were able to earn a sufficient margin of profit to maintain adequate reserves for essential renewals.

A Remedy for Dock Strikes

Correspondence on the Proposals by "Poseidon"

These further letters have been received in reply to the article on "A Remedy for Dock Strikes" which appeared in the October, 1958, issue of this Journal.

Sir,—From the correspondence you have already received, it is evident that practically every responsible official in the industry agrees that the National Dock Labour Scheme is here to stay, and that any action taken to reduce the incidence of dock strikes will have to be within the framework of the Scheme. It is also apparent that, for many years ahead, nothing is likely to disturb either the provisions governing decasualisation, or the arrangement by which the labour force is managed jointly by representatives of employers and labour respectively.

The main problem is how to stop unofficial strikes and other abuses. On the one hand, steps must be taken to reduce the number of disputes which arise; on the other hand, suitable disciplinary penalties must be imposed on any employer or dock worker who may act irresponsibly.

How can this be achieved? The difficulties can be discussed ad infinitum but there will be no improvement without action. If we cannot have fewer employers, cannot we have more uniformity of practice among them? Perhaps a useful step would be to form an employers' subcommittee to consider the effects on the industry of present methods of competing for dock labour. Must, for instance, employers compete with one another by offering payments outside those laid down in negotiated agreements? Secondly, something constructive would perhaps be achieved if the employers and the unions jointly discussed means of improving the disciplinary machinery within the framework of the existing scheme.

Yours faithfully,

18th December, 1958. PARTICIPANT.

Sir,—In your issue for October last, "Poseidon" re-opened the debate concerning the future of the docks with a resounding barrage which was generally directed towards the right targets but often out of range.

The master key to the whole situation is obviously the establishment of a **real understanding** between the two sides. This means something **much deeper** than the pleasant personal relationships which often exist between the leading employers and union representatives and which are sometimes paraded as evidence of a sound understanding. When that happy position has been reached the dock industry will be able for the first time to say, as they do in the steel industry, "we talk the same language and we trust each other."

This right understanding will be difficult to achieve as, quite apart from its unhappy background, the dock industry has many unique problems; two in particular are:—

(a) violent and unpredictable variations in labour requirements. (e.g. during 1957 the requirements of daily labour in Manchester ranged from 994 to 3,372, with an average register of 2,980).

(b) the multiplicity of dock employers (ranging from Master Stevedores whose only concern is the handling of cargo, to builders' merchants who may require a couple of gangs once in a blue moon) with no ring fence and consequently no community of interest.

Not even our all-wise planners could produce a panacea, but almost anything would be preferable to the present state of inertia which envelopes the industry.

Poseidon rightly states that a Royal Commission "would learn in its ponderous process that which employers could tell the Minister in half an hour." Equally the unions could open the Minister's eyes in the same short time. The industry is however big enough to find the right answers itself if only it could get away from the mystifying fear of change. Fresh ideas seem anathema and new policies are suspect so that the old casual practices and absurdities are retained and are reflected in high port charges.

The U.K. lags well behind its Continental competitors in its understanding and solution of dock labour problems. Your readers who have any knowledge of the training schools in the ports of Amsterdam and Rotterdam will have no doubt of their value not only in the practical side of all types of cargo handling but also in the development of moral standards, physical fitness and general intelligence.

The following points, grouped under inter-related headings, are submitted as offering a way out of the present impasse.

(1) **Sanctity of Agreements.** The Ernest Bevin tradition of hard bargaining followed by scrupulous observance of agreements should be accepted as a cardinal principle.

(2) **Retirement, Mechanisation and Redundancy.** The problem of retiring allowances to elderly daily workers is not as difficult as is sometimes urged. The hard fact is that since the decasualisation schemes were introduced in 1941 a vast sum of money, probably over a million pounds, has been paid out, by way of attendance money and guarantee, to elderly and infirm men who, despite long service, are still required to go through the daily farce of "looking for work" at 7.45 a.m.

In its 1957 Report the Board shows the percentage of daily workers over 65 years of age to be nearly double those under 25 years. A modest allowance to men at 65 would reduce the registers substantially and clear the ground for the introduction of full blooded mechanisation without any fear of redundancy.

(3) **Call Times, Half Daily Engagements and Transfer of Labour.** The present rigid system of call times at 7.45 a.m. and 12.45 p.m. which stems from the first National Dock Agreement of 1920 was based on payment of wages on a half daily basis. Notwithstanding that decasualisation has operated for nearly 20 years the half day basis is illogically retained.

Labour engagements are determined primarily by tides and although the present call times are hallowed by 40 years of usage, they offer few practical advantages to the employers and hold serious disadvantages for the men, who, if not engaged at 7.45 a.m., must either pay their fares home between calls or hang about the docks for five hours, an easy prey to the dissident groups.

Half daily payments should go and, as a quid pro quo, the men should accept a measure of fluidity, so that ships docking at, say, 9.30 a.m., would not have to wait until 1 p.m. for a start. When the tide was flowing at, say, 5 a.m., men not engaged at 7.45 a.m. should be released for the day.

A sensible arrangement on these lines ought to lead to the removal of the restrictions on the transfer of labour, all of which were built up by the unions to protect the men in days of casual labour.

(4) **Recruitment and Training.** Although the hereditary system is not favoured by the T.U.C. it is the main principle applied by the dockers' unions. Other things being equal there is no reason to quarrel with the view that dockers should be allowed to nominate their sons but there ought to be pre-entry medical examinations to rule out the halt and the maimed.

It appears to be generally assumed that not only is a docker's son of the right type but that he has inherited such a wealth of intuitive knowledge that he can tackle the intricate problems of cargo handling without any preliminary training and without endangering his mates' lives. So we have the spectacle of union officials opposing the establishment of training schemes in a hazardous industry where wages are high because of the dangers and difficulties of the work.

Much uninformed comment has been made about the engagement of labour. It is generally believed that the Scheme prevents the employers from engaging their own labour. This is quite incorrect. In every port of the country, except Southampton and South Wales, employers are free to engage any man on call who wishes to accept employment and conversely every man is free to seek the job he prefers. The Board's officers only come into the picture to fill vacancies which the employer has reported. The scenes when good and bad jobs are on offer at the same time must be seen to be believed. The waste of time is fantastic and a vital clause (16) of the National Agreement of 1920 is systematically disregarded so that the eight hour day

A Remedy for Dock Strikes—continued

seldom produces more than 6½ hours' productive work. The position is particularly bad in London and Glasgow where it is a daily occurrence for an hour to be wasted before part manned gangs are made up to full strength.

In Southampton and South Wales the Board's officers engage all labour at all times and no man knows the order in which the jobs are being filled. Readers who have had experience of the free and the controlled calls might give their views on this debatable point.

Yours faithfully,

5th January, 1959. "SCRUTATOR."

Conference on Berthing and Cargo Handling

During October last, a conference on Berthing and Cargo Handling in Exposed Locations was held at Princeton University, U.S.A., in connection with the Engineering School's River and Harbour Programme which is an activity of the Department of Civil Engineering. The subject of the conference was suggested by the fact that some of the huge tankers and bulk cargo carriers recently built and building are too large to reach existing berths in the protected waters of many of their normal ports of call. The cost of the channel improvements required to make existing piers and wharves accessible to these vessels, some of which are larger than the Queen Mary and Queen Elizabeth, might in many cases be so great as to be prohibitive. A study of the feasibility of berthing, loading and unloading such vessels in relatively unprotected waters was therefore of great importance.

Furthermore it was felt that any study of the response of ships to wave action would yield information important to persons dealing with the development of "roll-on, roll-off" and allied methods of loading and unloading cargo vessels of normal size in both protected and unprotected waters, as many such methods require a degree of fixity between the ship and the pier or wharf that is not demanded by conventional cargo handling through hatches.

The conference lasted two days and was attended by 172 delegates from industrial firms, offices of consulting engineers, contractors, and the Governments of the United States and Canada. Eight papers were presented on subjects and by speakers as listed below:

The Energy Problem by B. W. Wilson, Associate Professor of Oceanography and Meteorology, Agricultural and Mechanical College of Texas.
The response of a ship to waves and methods of estimating the total kinetic energy which must be absorbed by permissible deformations of the ship, the fender system and the pier.

Energy Absorption by the Ship by Edward V. Lewis, Head of the Ship Division, Stevens Experimental Towing Tank, and Sidney F. Borg, Head of Civil Engineering, Stevens Institute of Technology.
Considerations leading to the berthing of ships in unprotected waters. Ship structural design from the point of view of energy absorption and the avoidance of berthing damage.

Elastic Fender Systems by Zusse Levinton, Tippetts-Abbett-McCarthy-Stratton.
The energy absorbing capabilities of fender systems which absorb energy by non-destructive elastic deformation of specially introduced elastic members, such as springs or rubber cushions.

Gravity Fender System by A. L. L. Baker, Professor of Concrete Technology, University of London.
The energy absorbing capabilities of fender systems which absorb energy either by lifting the entire fender system or by lifting heavy components provided for energy absorption.

Energy Absorption by the Pier or Wharf Structure by E. H. Praeger, Praeger-Kavanagh.
Methods of estimating the capacity of the pier or wharf to absorb energy without suffering damage, and the effect on pier design of energy absorption considerations.

The Sea Berth by Captain R. M. Stall, California Shipping Company.
Loading and unloading super-tankers at sea berths by submarine pipelines—no pier or wharf.

Offshore Mooring Facilities for Tankers by F. H. Stracke, Esso Research and Engineering Company.
Discussion of associated design problems for ships up to 100,000 d.w.t. capacity.

The Ship Handling Problem by B. W. Havens, Socony Mobil Oil Company.
The feasibility of bringing ships alongside a pier or wharf, or mooring them at sea berths, in exposed locations.

A discussion period followed the presentation of each paper. The value of the conference was greatly enhanced by the effectiveness of the audience participation in these discussion periods.

This was the third and also the best attended conference on some phase of river and harbour engineering which has been held at Princeton. The first conference was held in October 1956 on the subject of Cofferdams. The 1957 conference was on The Design of Bulkheads and Quay Walls. The next conference which is tentatively scheduled for January 1960 will be on Navigation Problems of the St. Lawrence Seaway and the Great Lakes.

Manufacturers' Announcements

The National Boat Show

The fifth annual National Boat Show opened at Olympia, London, on 31st December last, and contained some 230 stands. While following the pattern set in previous years, this Show was notable for the predominance of the glass-fibre method of construction over the conventional use of wood and metal. Of all the craft on show, about half had hulls of glass-fibre, ranging from the 56-ft. "Bevinda," built by Halmatic Ltd., to small dinghies.

The main exhibit on the stand of **John I. Thornycroft & Co. Ltd.** was a glass-fibre hull 28-ft. 6-in. in length and with a beam of 8-ft. 9-in. This Company is now offering bare glass-fibre hulls for completion by other boatbuilders to customers' requirements. Apart from the one displayed, they are also producing two other standard hulls, one 16-ft. long with a beam of 5-ft. 10-in., the other, 24-ft. by 7-ft. 6-in. On their stand was also displayed a number of marine diesel engines ranging in size from 12½ to 125 b.h.p.

Another company exhibiting a range of marine diesel engines was **Lister Blackstone Marine Ltd.** Among the engines on show, which had powers varying from 1½ s.h.p. to 80 h.p., was a single cylinder unit developing 4½ h.p. with reverse gear and hand starting. Another was a 3 cylinder opposed piston unit developing 80 h.p. with reverse and reduction gear, electric starting and wet sump lubrication.

Petters Ltd. have enlarged the range of their marine engines and now have available units from 1½ h.p. to 104 h.p. This year they showed seven engines, both air and water-cooled.

One interesting exhibit on the stand of **Captain O. M. Watts Ltd.** was a miniature, fully transistorised echo-sounder, suitable for installation in small craft. It is capable of recording depths down to about 200-ft. and is priced at £34.

Lambie (Wallsend) Ltd., who have been building boats since 1870, have now developed a glass-fibre lifeboat of monolithic construction—keel, stem, sternpost, hull and gunwale all in one moulding, thus eliminating hull seams. Seating, thwarts, buoyancy compartments (filled with foam plastic) are also in one moulding and are bonded into the hull. The standard colours for a lifeboat of white exterior and orange interior are pigmented into the resins so that the boat requires no painting.

Another lifeboat on show was the new 42-ft. "Alfred and Patience Gottwald," exhibited by the Royal National Lifeboat Institution prior to being stationed at Aldeburgh, Suffolk.

There were several foreign exhibitors represented at the show, mainly from the Continent, one of which was a Dutch firm showing a plastic motor cruiser.

On their stand, British Waterways indicated the increasing facilities for boating on the British inland waterways.

Manufacturers' Announcements—continued

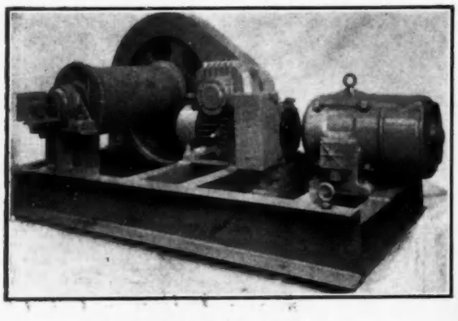
New Range of Standard Powered Winches

For many years Richard C. Gibbins & Co. Limited, of Berkeley Street, Birmingham, has been building powered winches which have provided for the special requirements of the individual user, and it was generally regarded as impracticable to evolve a standard winch design that might be integrated into a production line.

However, following the study of data relating to the large number of powered winches which the Company has built, a range of winches of standard design has been produced to cover direct loads ranging from $\frac{1}{2}$ ton to 7 tons, and for a range of mean rope speeds from 10 to 300-ft. per minute, depending upon the direct load.

There are two versions of these standard winches—one version being equipped with squirrel cage motors, the other with slipring motors.

The specifications for both are the result of careful study between the requirements of sufficiently robust design to give long life and low maintenance, and the need to avoid costly over-elaboration of design in the interests of economy. Already a number of these standard powered winches have been supplied, and they are proving in service to be all that the manufacturers expected.



A standard powered winch.

Electrical Companies Merge

Metal Industries Limited have announced further steps towards the closer association of its two electrical subsidiaries, Brookhirst Switchgear Limited of Chester and Igranic Electric Company of Bedford.

A new company, Brookhirst Igranic Limited, has been formed with Sir Charles Westlake (Chairman of Metal Industries) as chairman.

Closer association of the two companies was envisaged by Sir Charles in his statement to stockholders last July. He then said: "To enable the Group to play an increasing part in the rapid developments which are taking place in the electrical field we have decided to bring the two electrical control gear subsidiaries under one management. In this way we shall be able to make the best use of our resources by combining the technical skills, the research facilities and the sales organisations of the two companies and pooling their accumulated knowledge and experience."

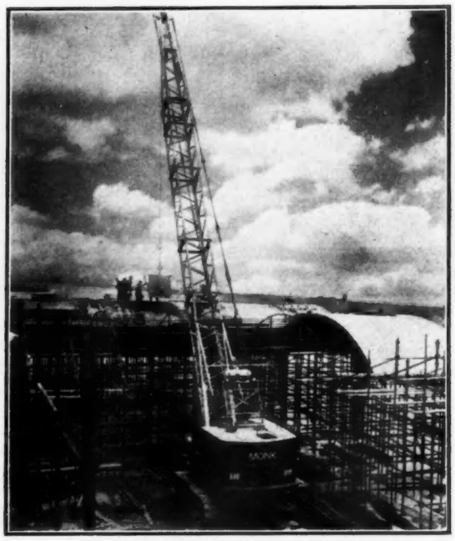
Electric Cranes for King's Lynn Docks

The British Transport Commission have placed an order with Thomas Smith & Sons (Rodley) Ltd., Rodley, Leeds, for six level-luffing electrically-operated portal cranes for use at Bentinck Dock, King's Lynn. The cranes will normally operate at a maximum load of 4 tons, but two of them will be capable of lifting single loads weighing up to $7\frac{1}{2}$ tons. All six cranes will be equipped for the discharge of bulk dry cargoes by grab.

The new equipment will replace existing hydraulic cranes of lower capacity, as part of the £250,000 scheme already announced for the modernisation of the south-east quay at Bentinck Dock. This scheme provides also for the re-surfacing of the quay in concrete; the renewal and strengthening of the crane tracks; and new and improved railway layout.

Reconstruction Contract at Hull

The fast hoist-speed, manoeuvrability and general efficiency of the NCK 605 crane, with its 90-ft. boom, are being practically demonstrated in a new way on the reconstruction of the Albert Dock and Riverside Quay, Hull. Work on the contract started in January, 1957, and is now nearing completion.



An NCK 605 seen in operation.

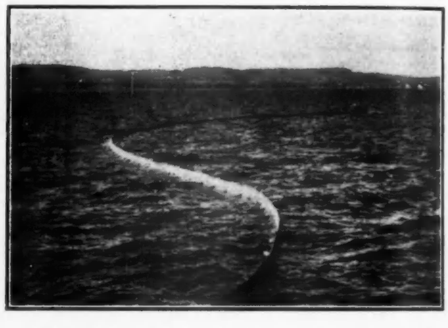
In the re-building of the quay and dockside, which were destroyed during the war, a special method of concrete roofing is being employed for only the second time in Great Britain. Pre-stressed, barrel-vault roofs are being constructed in the erection of four sheds (288-ft. x 80-ft.) on the Albert Quay, and three sheds (280-ft. x 79-ft.) on the Riverside Quay. This system of roofing dispenses with supporting columns, giving greater floor space for storage.

The principal contractors for the British Transport Commission are A. Monk & Co. Ltd., of Padgate, Warrington, who have used for several applications a number of NCK cranes made by Newton Chambers & Co. Ltd., of Thorncliffe.

Once work has started on the laying of concrete for one of the roof-vaults, it must be completed without being left overnight. The crane feeds the spreaders with concrete by the cubic yard, lifting a bucket-load from ground level to the exact location of the work in a few seconds. The machine fills the needs of six spreaders and six finishers employed laying the $\frac{3}{4}$-in. concrete skin; in the "valley beams," the thickness of the concrete varies according to fall, but the average is 2-ft. 4-in. The larger sheds—on the Albert Quay—have eight vaults, each with a 36-ft. span, and the other buildings each have seven vaults, each vault spanning 40-ft.

A New Type of Oil Boom

A device for containing oil after an accidental pollution of the sea or of river waters by oil from cargo ships or tankers has been invented by a Norwegian engineer. It consists of a flexible boom which can be drawn round the patch of floating oil and so prevent it from spreading. The oil can then be concentrated and disposed of through suction pipes.



The oil boom being laid by a motor launch.

The boom was invented by Mr. Trygve Thune of Oslo. It consists of plastic-coated linen strips about 50 yards long and 3-ft. wide, stiffened with aluminium rods and stabilised by lead weights at one yard intervals. Its floats are of compact plastic cork and it rides vertically on the water, 2-ft. below and 1-ft. above the surface. In a swell or in a choppy sea the lower edge will always be deep enough in the water to prevent any escape of oil. The strips are connected by terylene strings which can be used to draw in the boom and thus to concentrate the flowing oil. The boom can be laid from a rowing boat or from a motor launch.

Shell in Norway have sponsored and demonstrated the device. An example of its use occurred in the Oslo Fiord when a quantity of fuel oil from a burst hose ran into the water. Five hundred yards of the boom were run out to encircle the oil, which was recovered without damage to hundreds of sailing boats competing in a regatta in the area.